Gatton College of Business and Economics

The Effects of Opioids on Kentucky's Workforce

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Department for Public Health
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Executive Summary

Opioid abuse represents a significant and growing public health issue for both the nation and Kentucky. In 2016, opioids contributed to more than 62,000 deaths nationally and 1,406 deaths in Kentucky. National studies have placed the societal costs of opioid abuse at $55.7 billion in 2007 and $78.5 billion in 2013 (Birbaum et al. (2011) and Florence et al. (2016)). These costs included increased health care expenditures, higher criminal justice costs, and lost earnings due to reduced employment and premature deaths. The While House Council of Economic Advisors (2017) estimated the societal costs of opioid abuse to be much higher when the value of lives lost are included. They estimated the cost of opioid abuse to be $504 billion in 2015.

Growth in opioid abuse creates fiscal pressures for state and local agencies by increasing the needs for foster care, health care, criminal justice programs, and many other types of public services. Because opioid abuse can also reduce employment and earnings, it adds to these fiscal pressures by reducing tax collections.

To better understand these fiscal pressures, the Department of Public Health contracted with the University of Kentucky's Center for Business and Economic Research (CBER) to study how opioid abuse affects the state's workforce. This study has three main goals:

1. estimate the effect opioid abuse has on Kentucky's workforce;
2. estimate the effect opioid abuse has on state tax revenues; and
3. examine how public programs designed to address opioid abuse could affect the state's workforce and tax revenues.

The growth in opioid abuse is estimated to have reduced Kentucky's labor force participation rate by 1.3 to 3.1 percentage points. This translates to a loss of 23,100 to 55,200 workers, $1.0 to $2.8 billion in earnings, and $63 to $169 million in state tax revenues. However, there is still considerable uncertainty regarding the extent to which opioids reduce labor force participation.

Opioid-related deaths represent an additional economic loss to the state. In the absence of these premature deaths, many of these individuals might have worked and earned an income for many years. In 2016, opioids contributed to 1,374 deaths of Kentucky residents under the age of 65. Had these individuals been able to live out their natural lives they would have generated $348.3 million to $697 million in lifetime earnings and $20.9 million to $42 million in state tax revenues. These lifetime losses are spread over many years and do not represent the losses in any one year.

Losses for any single year reflect the cumulative effects of opioid-related deaths that occurred several years before. For example, opioid-related deaths occurring from 2007 through 2016 are estimated to have reduced earnings by $155 million to $310 million and state tax revenues by $9.3 million to $18.6 million in 2017.

For those who continue to work, opioid abuse can increase absenteeism and reduce their productivity while at work. This reduced productivity is estimated to cost the state's economy $240 million annually. If all of this lost productivity is passed on to workers in the form of lower wages, this would amount to a loss of $14.4 million in state tax revenues per year.

There is strong evidence that state level policies such as prescription drug monitoring programs (PDMP) and medically-assisted treatment can help address opioid abuse. However, there appears to be little research examining how these programs might affect employment and earnings.

Although the research is mixed, one study did find that PDMP resulted in 1.12 fewer opioid-related deaths per 100,000 people (Patrick et al. 2016). This would suggest Kentucky's KASPER program, which was established in 1999, may prevent 50 deaths and the loss of $25.3 million in lifetime earnings and $1.5 million in lifetime state tax revenues each year. Again, these lifetime earnings and tax revenues are spread over many years, so they do not represent an annual fiscal impact.

Overall, opioid abuse is estimated to reduce state tax revenues by $96 million to $202 million annually. These lower tax revenues include losses from reduced employment, premature deaths from the preceding 10 years, and reduced productivity. These losses are in addition to any increased expenditures state agencies incur due to opioid abuse.

Section 1: Introduction

The Kentucky Department of Public Health is responsible for improving the health and safety of Kentucky's residents by preventing disease and injuries and encouraging healthy lifestyles. The department administers nearly 150 programs that address critical health issues affecting Kentuckians. These programs screen newborns for health problems, prevent the spread of infectious diseases, promote oral health, and provide numerous other services.

Opioid abuse represents a significant and growing public health issue for both the nation and Kentucky. Data from the U.S. Centers for Disease Control and Prevention indicate that there were 62,492 deaths involving opioids in the United States in 2016. With 1,406 opioid-related deaths, Kentucky has been disproportionately hit by these loses. While Kentucky accounts for only 1.4 percent of the U.S. population, it accounts for 2.25 percent of opioid-related deaths.

In addition to the loss of life, opioid abuse imposes significant costs on society. Birbaum et al. (2011) estimated that opioid abuse cost the nation $55.7 billion in 2007. These costs included increased health care expenditures, higher criminal justice costs, and lost earnings due to reduced employment and premature deaths. Florence et al. (2016) estimated that opioid abuse cost the nation $78.5 billion in 2013. As high as these estimates were, the U.S. White House Council of Economic Advisors (2017) noted that they understate the true costs of opioids because they only accounted for lost earnings associated with opioid-related deaths rather than the value of the lives lost. The council estimated opioids actually cost the nation $504 billion in 2015.

The growing rate of opioid abuse in Kentucky increases the fiscal pressures placed on state and local agencies that provide foster care, health care, criminal justice programs, and many other types of public services. Opioid abuse can also reduce tax collections. Lost earnings from reduced employment and premature deaths accounted for 34.3 percent of the costs estimated by Birnbaum et al. (2011) and over half of the costs estimated by Florence et al. (2016). These lost earnings result in lower tax revenues for federal, state, and local governments, compounding the fiscal pressures created by opioid abuse.

To better understand these fiscal pressures, the Department of Public Health contracted with the University of Kentucky's Center for Business and Economic Research (CBER) to study how opioid abuse affects the state's workforce. This study has three main goals:

1. estimate the effect opioid abuse has on Kentucky's workforce;
2. estimate the effect opioid abuse has on state tax revenues; and
3. examine how public programs designed to address opioid abuse could affect the state's workforce and tax revenues.

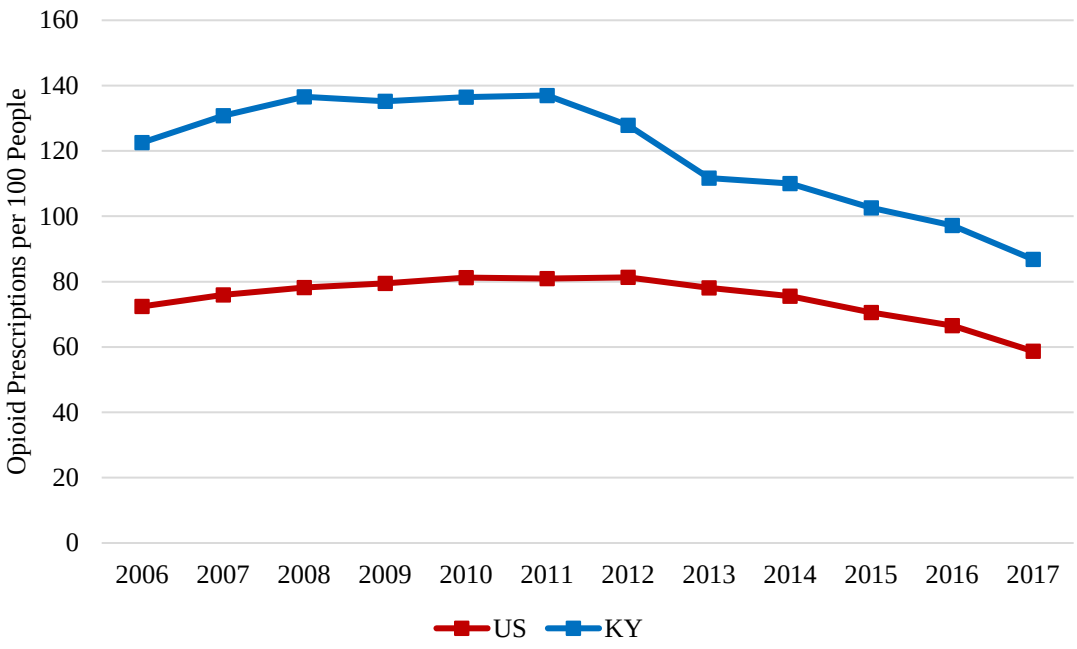
Section 2: Impact of Opioids on Employment and Earnings

Reduced Employment and Earnings

The available data suggests that the use of prescription opioids increased quickly during the early 2000s. The CDC estimated that the amount of prescription opioids per person increased from 180 morphine milligram equivalents (MME) in 1999 to 640 MME in 2015, an increase of 255 percent. Figure A shows the number of initial and refill opioid prescriptions dispensed per 100 people in the U.S. and Kentucky.[1] Unfortunately, the CDC only publishes prescribing rates for the nation and individual states since 2006—after much of the growth appears to have occurred. Therefore, it is not entirely clear how quickly Kentucky's prescription opioid rate increased.

Opioid prescribing peaked nationally around 2010 through 2012. Prescribing peaked in Kentucky in 2011 at 137 prescriptions per 100 people—giving Kentucky one of the highest prescribing rates in the nation. This high rate may reflect the degree to which opioids were over prescribed but might also reflect the extent to which opioids were diverted to non-medical purposes. Rates in Kentucky declined by seven percent in 2012 and 13 percent in 2013. While opioid prescribing has decreased faster in Kentucky than the U.S., rates in Kentucky are still nearly 50 percent higher than the nation.

Figure A
Number of Opioid Prescriptions per 100 People
U.S. and Kentucky



Source: U.S. Centers for Disease Control and Prevention. U.S. Opioid Prescribing Rate Maps.

[1] Prescribing rates do not provide information about the dosage prescribed and do not include prescriptions filled by mail order pharmacies.

Several recent studies have examined the relationship between the increasing use of opioids and employment trends nationally. Estimating the degree to which opioid use affects employment is complicated by several issues. First, opioids can potentially have both negative and positive effects on employment. Abusing opioids may make individuals less likely to work or maintain employment—suggesting a negative effect. However, opioids might provide a treatment option for those who suffer from severe pain, allowing them to manage their pain and continue working. Other underlying factors may also contribute to both an increased use of opioids and reduced employment. For example, as Krueger (2017) points out, areas with high obesity rates may see both a greater use of opioids and lower labor force participation. In this case, obesity could drive both the greater use of opioids and lower levels of employment rather than opioids driving the lower level of employment. Finally, poor employment prospects may contribute to the greater abuse of opioids. In these situations, high levels of unemployment would be contributing to the greater use of opioids.

Most of the current estimates suggest that opioids negatively affect labor force participation and employment in the U.S. However, researchers are still working on how to best isolate the degree to which opioids causes lower levels of employment. Krueger (2017) estimated that the increase in opioid prescribing from 1999 to 2015 may have reduced the nation's labor force participation by 0.6 percentage points for males and 0.77 percentage points for females. Aliprantis and Schweitzer (2018) also found that rising opioid prescription rates were associated with lower labor force participation among those aged 24 to 54. They provide a range of estimates suggesting that a 10 percent increase in the opioid prescribing rate was associated with as much as a one-half percentage point decrease in the labor force participation rate for men and a 0.14 percent decrease for women. Harris et al. (2017) estimate that a 10 percent increase in prescription opioids lead to a 0.64 percentage point decrease in the employment to population ratio. Currie, Jin, and Schnell (2018) found no relationship between opioid prescriptions and employment for men and that the increase in prescribing was associated with increased employment for women.

The complexity of the issue and the differing estimates suggest that more research is needed to fully understand how opioids affect employment. Krueger made this point clear when he explicitly warned that his analysis was preliminary and that other factors "influencing both opioid usage and low labor force participation" may have affected his estimates. Nevertheless, these studies do provide important information on how the growth in prescription opioids may have affected the economy.

Aliprantis and Schweitzer (2018) provided several sets of estimates of the relationship between opioid prescription rates and the labor force participation of males and females. Table 1 uses the two sets of estimates that provided the smallest and largest effects on labor force participation to illustrate how the growth in prescription opioids may have affected Kentucky's employment. The figures in Table 1 show the effect of Kentucky's opioid prescribing rate increasing from 46

prescriptions per 100 people to its peak of 137. This represents an increase of nearly 200 percent.[2]

In 2017, 74 percent of females and 81 percent of males between the ages of 24 and 54 in Kentucky were in the labor force. Approximately 95 percent of both males and females who were in the labor force were also employed.

The lowest set of estimates suggests that the increase in opioids reduced Kentucky's labor force participation by 1.5 percentage points for females and 1.2 percentage points for males. This represents a total reduction of 1.3 percentage points in Kentucky's labor force participation, or 23,100 workers.[3] The reduction in workers translates to a loss of $1 billion in earnings and $63 million in state income and sales tax revenue per year. State tax revenues are based on a total effective state income and sales tax rate of six percent.

The highest set of estimates suggests that the increase in opioids reduced labor force participation by 1.5 percentage points for females and five percentage points for males. This represents a total reduction of 3.1 percentage points in Kentucky's labor force participation, or approximately 55,200 workers. The reduction in workers translates to a loss of $2.8 billion in earnings and $169 million in state income and sales tax revenue per year.

Gitis (2018) provided an alternative estimate of lost employment using the results from Krueger (2017). He estimated that Kentucky lost approximately 48,200 workers due to the growth in opioids, well within the range of estimates provided in Table 1.

The estimates in Table 1 are sensitive to the range of growth considered. The estimates show the amount of employment lost as opioid prescribing rates increased from 46 to 137 per 100 people, a 200 percent increase. It might seem natural to evaluate how going from no opioids to the peak of 137 prescriptions per 100 people influenced Kentucky's employment. However, studies estimating the relationship between prescribing rates and employment or labor force participation generally did not include data during periods or in areas where opioids were not prescribed. So the estimates of how opioid prescribing affects employment or labor force participation may not be reliable over this range. There is also risk that selecting too small a range of growth would understate the total losses associated with opioids. For example, basing the estimates on an increase from 69 to 137 prescriptions per 100 people would suggest a loss of only 14,600 to 35,000 workers, but would miss a significant portion of the growth in opioid prescribing.

[2] As discussed, prescribing rates are not available prior to 2006. Therefore, it is not clear how long it took for Kentucky's prescribing rate to increase by this amount.

[3] The percentage point change in labor force participation rates due to opioids was calculated by multiplying the coefficients from Aliprantis and Schweitzer (2018) by the difference between the natural log of 137 and 46. These percentage point changes were multiplied by the population between the age of 24 and 54 and 95 percent to calculate the number of workers lost.

Table 1
Effect of Growth in Prescription Opioids
on Kentucky's Labor Market

	Female	Male	Total
Kentucky Labor Market 2017			
Population (aged 24 to 54)	890,000	884,000	1,774,000
Labor Force Participation Rate	74.2%	80.9%	78%
Percent of Labor Force Employed	95.3%	95.1%	95.2%
Number Currently Employed	629,000	680,000	1,309,000
Effect of Opioids on Labor Market			
Low Estimates			
Labor Force Participation Rate (percentage point change)	-1.5%	-1.2%	-1.3%
Lost Employment (# of workers)	-13,000	-10,100	-23,100
Lost Earnings ($ millions)	-490	-556	-1,046
Lost State Tax Revenues ($ millions)	-29	-33	-63
High Estimates			
Labor Force Participation Rate (percentage point change)	-1.5%	-5.0%	-3.1%
Lost Employment (# of workers)	-13,000	-42,200	-55,200
Lost Earnings ($ millions)	-490	-2,325	-2,814
Lost State Tax Revenues ($ millions)	-29	-139	-169

Sources: CBER analysis of data from the 2017 American Community Survey and estimates from Aliprantis and Schweitzer (2018).
Notes: Estimates represent the employment lost as the opioid prescribing rate increased from 46 to 137 prescriptions per person.

The earnings estimated in Table 1 are based on the average earnings for men and women between the ages of 24 and 54 in Kentucky. Essentially, this assumes those who abused opioids could have earned the same amount as those who did not. However, there is little information to indicate how much opioid abusers would have actually earned in the absence of their addiction. If opioid addiction is more common among those who typically have lower earnings, then the estimates in Table 1 might overstate lost earnings. To address this, Table 2 provides estimates of the lost earnings and tax revenues using different assumptions about earnings. For example, assuming those who did not work because of opioids would have earned 50 percent of the state average, lost earnings would range from $523 million to $1,407 million and lost state tax revenues would range from $31 million to $84 million.

Table 2
Sensitivity Analysis on Lost Earnings

Earnings of Opioid Users Relative to Average	Low Estimates		High Estimates	
	Lost Earnings ($ millions)	Lost State Tax Revenue ($ millions)	Lost Earnings ($ millions)	Lost State Tax Revenue ($ millions)
100%	-1,046	-63	-2,814	-169
90%	-941	-56	-2,533	-152
80%	-837	-50	-2,252	-135
70%	-732	-44	-1,970	-118
60%	-628	-38	-1,689	-101
50%	-523	-31	-1,407	-84

Each of the studies discussed above examined the past relationship between the level of opioids prescribed and employment. They generally found that the increase in prescription opioids was associated with reduced employment. However, this relationship is likely changing. Doctors are much less likely to prescribe opioids than just a few years ago, as reflected in Figure A. As individuals who seek out opioids find that their access to prescription opioids is restricted, they may switch to illicit opioids or other drugs. As a result, policy makers may find that reducing opioid prescribing rates will not have as large of an effect in the future as the results from these retrospective studies might imply.

Employment and Earnings Lost to Opioid-Related Deaths

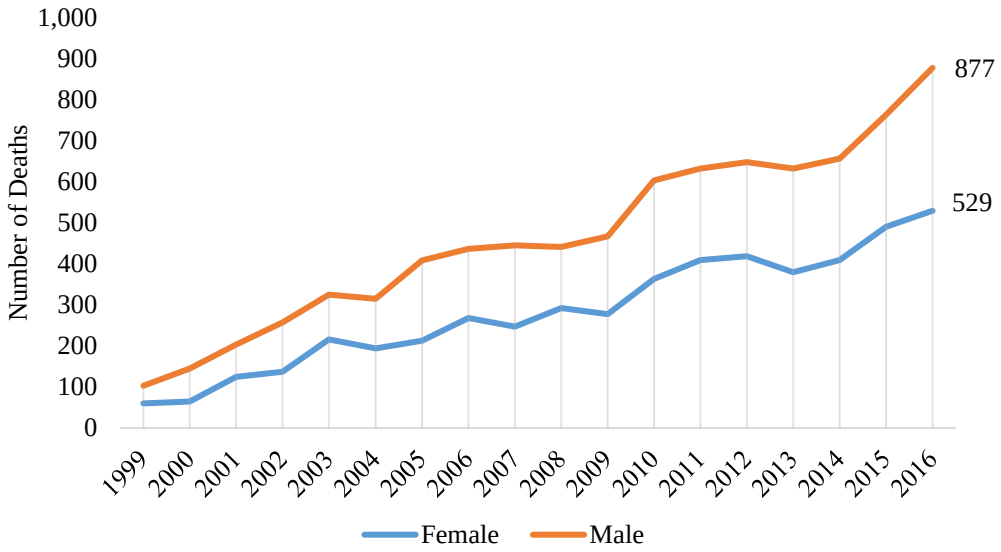
In 2006, opioids were listed as a contributing cause in 704 deaths in Kentucky.[4] Ten years later, this number had nearly doubled to 1,406. This represents an average annual growth rate of 7.2 percent. From 2010 through 2014, however, growth in the number of opioid-related deaths had slowed and actually even declined slightly in 2013. In 2015 and 2016, the state saw a spike in opioid-related deaths, and rates increased by 17.7 percent and 12.2 percent over the prior year, respectively.

Opioid-related deaths are growing among both males and females in Kentucky but are more prevalent among males (Figure B). In 2016, opioids played a role in 877 deaths among males and 529 deaths among females.

Figures C and D show trends in opioid-related deaths in Kentucky by gender and age. Table 3 shows annual average growth rates from 2006 through 2016 and the distribution of opioid-related deaths across age groups. While more males die from opioids than females, the overall growth rates are fairly similar. Growth in opioid-related deaths averaged 7.2 percent per year among males in Kentucky and 7.0 percent per year among females.

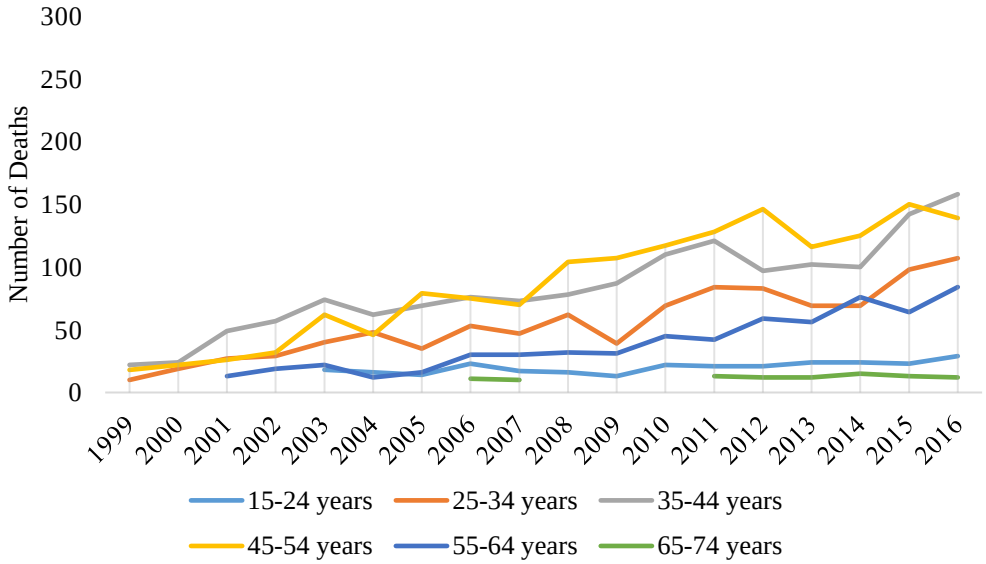
[4] This includes prescription opioids and illicit opioids.

Figure B
Opioid-Related Deaths
Kentucky



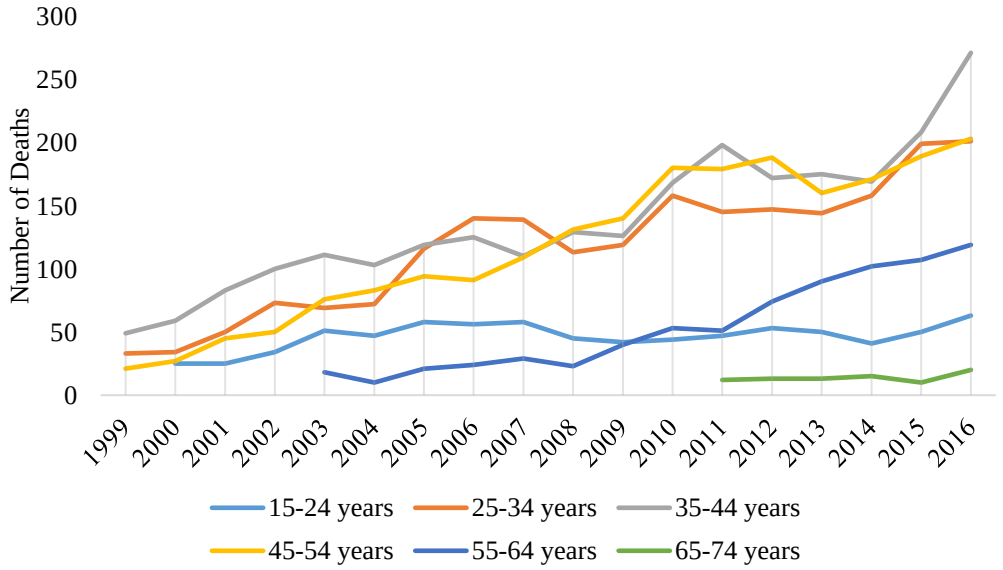
Source: U.S. Centers for Disease Control and Prevention. Multiple Cause of Death Files, 1999-2016, released December 2017.

Figure C
Opioid-Related Deaths among Females by Age
Kentucky



Source: U.S. Centers for Disease Control and Prevention. Multiple Cause of Death Files, 1999-2016, released December 2017.

Figure D
Opioid-Related Deaths among Males by Age
Kentucky



Source: U.S. Centers for Disease Control and Prevention. Multiple Cause of Death Files, 1999-2016, released December 2017.

Table 3
Share of Opioid-Related Deaths and
Annual Growth Rates by Age and Gender
Kentucky

	Share of Opioid-related Deaths in 2016		Annual Growth Rate from 2006 to 2016	
Age Group	**Females**	**Males**	**Females**	**Males**
15 – 24	5.5%	7.2%	2.3%	1.2%
25 – 34	20.2	22.9	7.3	3.7
35 – 44	29.9	30.9	7.6	8.0
45 – 54	26.3	23.1	6.4	8.4
55 – 64	15.9	13.6	10.8	17.4
65 - 74	2.3	2.3	0.9	n.a.
Total	100.0%	100.0%	7.0%	7.2%

Source: U.S. Centers for Disease Control and Prevention. Multiple Cause of Death Files, 1999-2016, released December 2017.

The rate of growth differs significantly across age groups. Deaths among females and males aged 15 to 24 grew 2.3 and 1.2 percent respectively. The annual growth rates were highest among those aged 55 to 64, 10.8 percent for females and 17.4 percent for males.

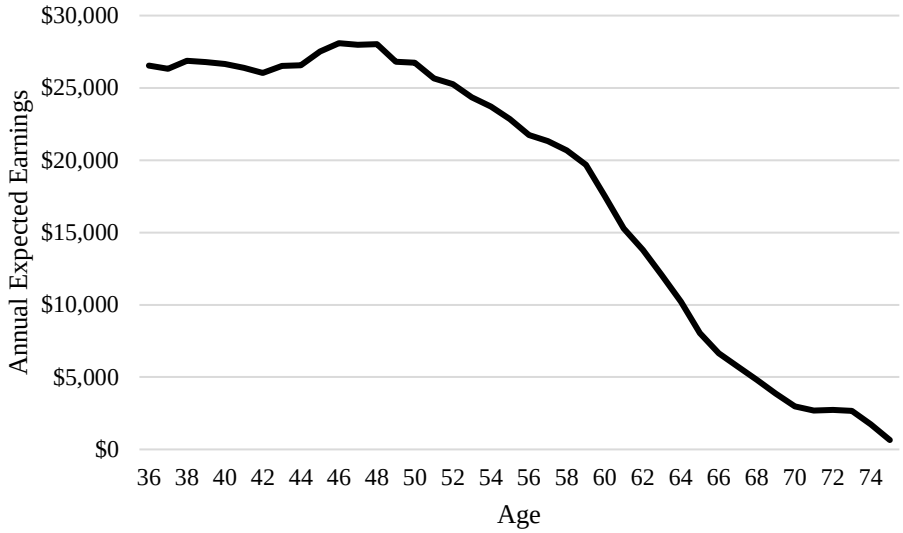
Most opioid-related deaths occur during prime working ages. Approximately 92 percent of deaths among females and 91 percent of deaths among males occurred between the ages of 25 and 64. These premature deaths represent additional economic losses to the state. In the absence of developing an addiction, some of these individuals might have been able to continue working and earn a living for many years. The remainder of this section examines the potential lifetime earnings that were lost to opioid-related deaths.

The CDC's Multiple Cause of Death Data records the age, gender, race, and causes of death listed on U.S. death certificates. Data on all deaths occurring in Kentucky that were related to opioids were extracted from this database along with the gender and an age range for each death. Given their gender and approximate age, the decedents' lost earnings were estimated based on the probability they would be alive, the probability they would be employed, and the average earnings they would have earned each year had they been able to live out their natural life.

The probability that decedents would be alive each year had they not died from opioids is based on actuarial life tables (United States Social Security Administration, 2005). These tables show the probability an individual will be alive each year in the future given their current age and gender. For example, the probability that a 35-year-old female would still be alive at age 50 is approximately 97 percent. The probability that an individual would work each year was based on the percentage of people working given their age and gender. In Kentucky, for example, 71 percent of 35-year-old females and 58 percent of 55-year- old females were employed. Average earnings simply represent the annual average earnings of those employed by age and gender. Data on the percent of Kentucky's residents who were employed and their average earnings if employed were obtained from Kentucky residents in the U.S. Census Bureau's American Community Survey. Employment rates and average earnings were also adjusted to reflect that opioid-related deaths are not evenly distributed across the state. Therefore, the employment rates and average earnings for those who died from opioids may differ somewhat from Kentucky residents as a whole.

Multiplying these three pieces of information for each year after an individual's death shows what each individual could have earned over their lifetime had they not died. Figure E shows the annual expected earnings for a 35-year-old female in Kentucky. The figures are lower than the average earnings often reported for females because they include those who do not work, and therefore, have no earnings. Had this individual been able to live out her natural life, she could have expected to earn approximately $747,000 over the rest of her life.

Figure E
Annual Expected Future Earnings
of a 35-year Old Female



Source: CBER staff analysis of data from the U.S. Census Bureau, American Community Survey.

A similar earnings profile was estimated for each individual who died due to opioids based on their gender and their age at death in 2016. Totaling the lost earnings for each individual yields an estimate of the total earnings lost due to opioid-related deaths. Only those who died before the age of 65 were included in the estimates.

In the discussion above, those who died due to opioids were assumed to have similar earnings as the average person of the same age and gender in Kentucky. As discussed earlier, their earnings in the absence of opioid abuse are not known. Those who died from overdosing on illicit drugs such as cocaine may have been less likely to work and earn lower wages. However, opioid addictions appear to frequently affect people who would not normally develop a drug addiction. Opioid addictions may have developed as physicians initially prescribed opioids to manage pain. These factors offset each other, and it is impossible to know which has a larger effect on the probability of working and earnings in the absence of opioid abuse.

The Kentucky Drug Overdose Fatality Surveillance System 2016 Annual Report, which was produced by the Kentucky Injury Prevention and Research Center, reports the industries in which those who died from drug overdoses were employed or affiliated (Table 4). Opioids were involved in 90 percent of fatal drug overdoses in Kentucky in 2016 ((Hargrove et al. 2018). The data suggests that fatal drug overdoses might be disproportionately represented among industries that tend to pay lower wages. Applying the average annual income for each industry from the ACS to the industry distribution for drug overdoses suggests that workers who die due to drug overdoses might have earned approximately 83 percent of what the average Kentucky worker

earned. This, however, does not account for other factors that might cause the earnings of those who abuse substances to differ from the earnings of non-abusers. Given the uncertainty of how much those who abuse opioids earn, a range of estimates was provided. The high estimates assume opioid abusers' earnings are similar to non-abusers. The low estimates assume opioid abusers earn 50 percent of what non-abusers earn. [5]

Table 4
Industry by Drug Overdose Decedent
Kentucky
2016

Industry	Count	Percent*
Construction	221	15.2
Other Industry, Not Classifiable, or Unspecified	212	14.6
Restaurants and Other Food Services	115	7.9
Not Specified Manufacturing Industries	53	3.6
Landscaping Services	39	2.7
Automotive Repair and Maintenance	38	2.6
Not Specified Retail Trade	28	1.9
Hospitals	27	1.9
Truck Transportation	23	1.6
Coal Mining	21	1.4
Beauty Salons	16	1.1
Independent Artists, Performing Arts, Spectator Sports, and Related Industries	16	1.1
Nursing Care Facilities	15	1.0
Crop Production	14	1.0
Grocery Stores	14	1.0
Commercial and Industrial Machinery and Equipment Repair and Maintenance	11	0.8
Real Estate	11	0.8
Outpatient Care Centers	10	0.7
Warehousing and Storage	10	0.7
Did Not Work	151	10.4
Homemaker	151	10.4
Students	34	2.3

Source: Kentucky Drug Overdose Fatality Surveillance System 2016 Annual Report.
*Percentage are based a total of 1,457 drug overdose deaths.

Table 5 summarizes the earnings and state tax revenues lost to opioid-related deaths in Kentucky. Assuming that opioid abusers and non-abusers earn similar amounts (the high estimates), lost earnings during the first year after death would total $43.9 million. These earnings would have generated approximately $2.6 million in state tax revenues assuming a six percent effective tax rate. Because many of these individuals died at a relatively early age, earnings and tax revenues are lost for many years. For example, a 34-year-old who overdosed

[5] Assuming that those who died due to opioids earn 50 percent of average earnings, lost earnings during the first year after death would total $21.95 million and lost state tax revenues would total $1.3 million. The present value of lifetime lost earnings would total $348.3 million and present value of lifetime lost tax revenues would total $20.9 million.

using opioids might have been able to work another 30 years in the absence of the addiction and premature death. The present value of lifetime earnings lost to opioid-related deaths in 2016 totaled $697 million. Present values were calculated using a discount rate of four percent. These earnings would have generated approximately $41.8 million in state tax revenue.

Assuming that those who died due to opioids earn 50 percent of average earnings (low estimates), lost earnings during the first year after death would total $21.9 million and lost state tax revenues would total $1.3 million. The present value of lifetime lost earnings would total $348.3 million and present value of lifetime lost tax revenues would total $20.9 million.

Table 5
Earnings and Tax Revenue Lost to Opioid-Related Deaths
Kentucky

	Low Estimates	High Estimates
Number of Opioid-Related Deaths under the age of 65 (2016)	1,374	1,374
Lost Earnings ($ millions)		
Present Value Lifetime	348.3	696.6
1st Year	21.9	43.9
Lost State Sales & Income Tax Revenue ($ millions)		
Present Value Lifetime	20.9	41.8
1st Year	1.3	2.6

Notes: Figures only include deaths occurring before the age of 65. A discount rate of four percent was used to calculate present values. Tax revenues were calculated assuming a total effective sales and income tax rate of six percent. The high estimates were based on an assumption that opioid abusers have similar earnings as non-abusers. Low estimates assume opioid abusers earn 50 percent of the amount that non-abusers earn.

Source: CBER staff analysis of data from the U.S. Centers for Disease Control and Prevention, Multiple Cause of Death Files, and the U.S. Census Bureau, American Community Survey.

The estimates in Table 5 only reflect losses for deaths that occurred in 2016. However, the earnings and tax revenues lost in any given year are much larger because they reflect the accumulation of deaths occurring for several preceding years. From 2007 through 2016, there were approximately 9,800 deaths related to opioids. Assuming that opioid abusers and non-abusers have similar earnings, opioid-related deaths were estimated to have reduced earnings and state tax revenues by $310 million and $18.6 million, respectively, in 2017. Given the assumption that opioid abusers earn 50 percent of the amount non-abusers earn, opioid-related deaths would reduce state earnings in 2017 by $155 million and state tax revenues by $9.3 million.

While this study focuses on lost earnings, economists often use the value of a statistical life (VSL) to measure the losses associated with death. The VSL represents the amount society would be willing to pay to prevent one death. VSL is often estimated by examining the

additional compensation workers require to take on additional risk. Current estimates suggest that the VSL is approximately $11 million on average in the U.S. (Boardman et al. 2018).

In a 2017 study, the White House Council of Economic Advisors used VSL to estimate the economic losses of opioid-related deaths. Their study estimated that the cost of opioid-related deaths in the U.S. was $431.7 billion in 2015. Brill and Ganz (2018) then estimated the distribution of these costs by state. Their estimates indicate that Kentucky's share of these costs amount to $2,412 per person, or $10.8 billion.

Absenteeism and Presenteeism

Many individuals who abuse opioids may continue to work, but are less productive during their employment. This lost productivity occurs in two main ways. First, these workers have higher rates of absenteeism. Second, even when at work, they may be less productive than they would be otherwise. This form of lost productivity is often referred to as presenteeism.

Rice et al. (2014) compared the number of work days lost among workers covered by large, self-insured employer insurance plans. They found that opioid abusers missed 13.1 more days of work than non-abusers. The U.S. Department of Justice estimated that drug abuse and dependency reduced worker productivity by 17 to 18 percent. Birnbaum et al. (2011) estimated that opioid-related absenteeism and presenteeism cost the U.S. $3.86 billion annually. Approximately 28.8 percent of these losses were attributed to caregivers who took time off work to care for someone with an opioid addiction. Their estimates suggest that the economic costs of absenteeism and presenteeism related to opioid abuse amounted to approximately 34 cents for every dollar of earnings lost to opioid-related deaths. Applying this ratio from Birnbaum et al. (2011) to the lost earnings from premature deaths in Kentucky suggests that opioid-related absenteeism and presenteeism cost the state's economy approximately $240 million annually in lost productivity.[6]

The extent to which this results in lost earnings for workers is unclear. Employers might initially bear the cost of lower productivity, but pass these costs on to workers in the form of slower wage growth. Assuming the full value of the lost productivity results in lost earnings suggests that the lost state tax revenues would be $14.4 million annually.

Section 3: Health Care Costs

Opioid abusers incur significantly higher health care costs than non-abusers. Nationally, these excess health care costs have been estimated to total nearly $33 billion (Birnbaum et al. 2011 and Florence et al. 2016).[7] White et al. (2005) found that the direct health care costs of opioid abusers was 8.7 times higher than non-abusers. They found that, compared to non-abusers, opioid abusers were four times more likely to visit the ER; 12 times more likely to have at least

[6] Adjustments were made to reflect that Birnbaum et al. (2011) and Table 4 used different discount rates to calculate the present value of lost earnings.
[7] Estimates were restated in 2018 dollars using the CPI-U for Medical Care.

one hospital inpatient visit; and 11 times more likely to have at least one mental health visit. Opioid abusers also suffer from numerous other health conditions, such as chronic lower back pain, hepatitis, and psychiatric disorders. In some cases, these other health conditions may be a cause rather than a consequence of opioid abuse.

White et al. (2011) compared the health care costs of opioid abusers to non-abusers using data from a private health insurance plan and Florida's Medicaid program. They found health care costs for abusers with private insurance were nearly $26,500 per person higher than for non-abusers. Cost for abusers enrolled in Florida's Medicaid program were $19,600 per person higher than for non-abusers.[8] Florence et al. (2016) estimated that the average additional health care cost per person was $17,672 for those with private insurance; $19,442 for those covered by Medicare; and $15,669 for those covered by Medicaid.[9]

Florence et al. (2016) also estimated that opioid abuse contributed to approximately $33 billion per year in health care costs for the nation. Kentucky's share of these costs can be estimated by applying Kentucky's share of the nation's opioid-related fatalities, or 2.25 percent in 2016. Applying this rate to the estimate of $33 billion suggests that Kentucky's share of the health care costs related to opioids totals $742 million annually. Florence et al. (2016) found that 21 percent of the total excess costs were paid by Medicaid. This would suggest that $156 million of Kentucky's costs are paid for by Medicaid. However, Kentucky's Medicaid program might pay more than this amount because a Medicaid covers a larger percentage of Kentucky's population than the nation's population.

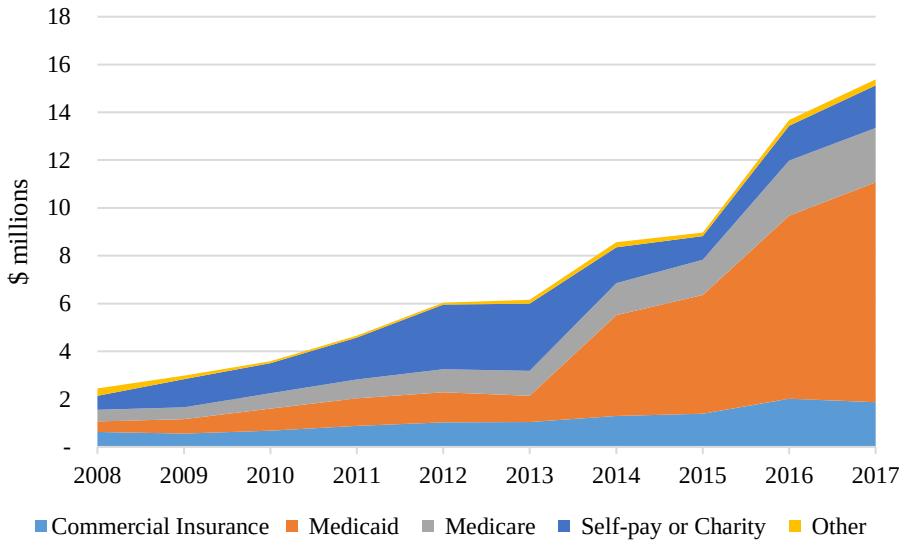
Because state and federal governments jointly fund Medicaid, Kentucky directly bears a portion of these charges. Kentucky's share of Medicaid expenses varies depending on how each Medicaid recipient qualifies for the program. For example, in 2019, Kentucky will pay 28.33 percent of the expenses for those eligible for traditional Medicaid and seven percent for those eligible for the Medicaid expansion.

Figures F and G show charges for drug overdose emergency room (ER) visits and inpatient hospitalizations that involve opioids in Kentucky. The data, which is maintained by the Kentucky Injury Prevention Research Center, suggests that Kentucky's Medicaid program bears a large portion of the opioid-related costs, at least for some medical services. Charges for both ER visits and inpatient hospitalizations have increased significantly since 2008. ER charges for opioid overdoses increased from $2.4 million in 2008 to $15.4 million in 2017 (Figure F). This represents an increase of nearly 530 percent. Inpatient hospitalization charges for opioid overdoses totaled $60.8 million in 2017 (Figure G).

Whether a charge is attributed to opioids depends on information recorded by hospital staff. Therefore, some of the increase for both ER visits and inpatient hospitalizations could be due to staff more accurately identifying whether opioids contributed to an overdose.

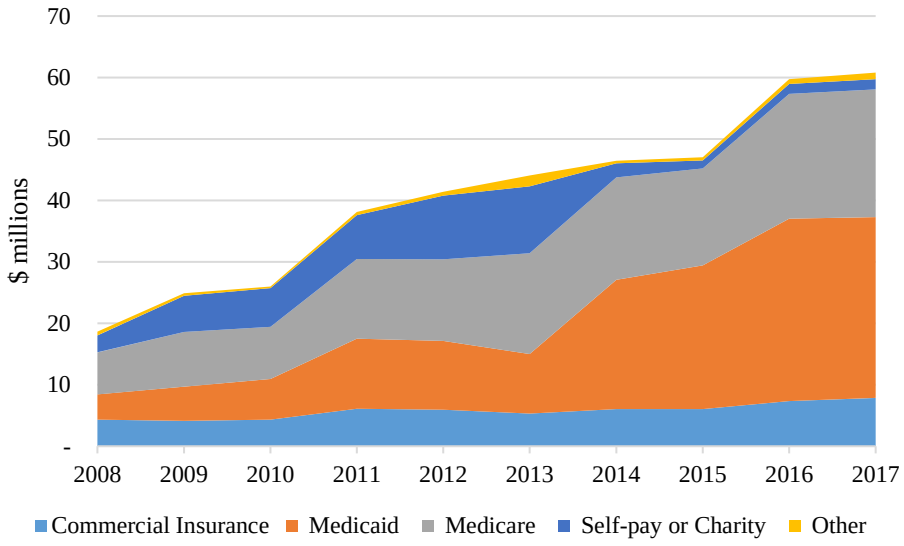
[8] Estimates were restated in 2018 dollars using the CPI-U for Medical Care.
[9] Estimates were restated in 2018 dollars using the CPI-U for Medical Care.

Figure F
Charges for Drug Overdose Emergency Room Visits Involving Opioids by Source of Payment
Kentucky



Source: Kentucky Injury Prevention Research Center.

Figure G
Charges for Drug Overdose Inpatient Hospitalizations Involving Opioids by Source of Payment
Kentucky



Source: Kentucky Injury Prevention Research Center.

Figures F & G also show the distributions of these charges by the expected payer. The data suggest that most of these charges are expected to be directed to Kentucky's Medicaid program.

Medicaid was expected to pay 60 percent of ER costs and 48 percent of the inpatient hospitalization costs related to opioid overdoses in 2017. Medicare was expected to pay 15 percent of ER visits and 34 percent of inpatient hospitalizations.

Section 4: Prevention & Treatment

The CDC lists several strategies that may help states prevent and treat opioid abuse, such as expanding first responders' access to naloxone and promoting the use of opioid prescribing guidelines. This section briefly discusses four of the more promising strategies—prescription drug monitoring programs (PDMP), medically-assisted treatment (MAT), naloxone distribution, and needle exchange programs. There is a growing body of research suggesting that these strategies are useful tools for managing opioid abuse. However, there appears to be little research examining whether they affect employment and earnings. The strategies are often deployed as parts of a broad, multi-pronged effort to combat opioid abuse, making identification of the effects of any single, isolated initiative difficult. As policy makers consider investing in strategies to address opioid abuse, they should weigh the costs against the benefits they provide to society. While these benefits may include improvements in employment and earnings, they are far from certain.

Prescription Drug Monitoring Programs

Prescription drug monitoring programs appear to be a promising tool for preventing opioid abuse. PDMPs are electronic databases developed by states to track prescriptions of controlled substances. Physicians and pharmacists can review patients' prescription history to determine whether they may be abusing or diverting controlled substances. Law enforcement agencies may use these programs to identify health care providers who may be overprescribing.

Several studies provide evidence that PDMPs are associated with reductions in opioid use. Reisman et al. (2009) concluded that states with a PDMP had significantly fewer oxycodone shipments than states without a PDMP. Reifler et al. (2012) showed that states with PDMPs experienced slower growth in opioid treatment admissions. Bao et at. (2016) found that the probability that ambulatory patients were prescribed schedule II opioids decreased by 30 percent (from a probability of 5.5 to 3.7 percent) in states that adopted PDMPs.

By reducing the incidence of opioid abuse, PDMPs may also affect state economies by improving labor force participation and reducing deaths. However, there appears to be no empirical research examining whether PDMPs affect labor force participation, and research has provided mixed results on whether PDMPs reduce fatal drug overdoses.

Paulozzi et al. (2011) found that states with PDMPs had higher drug overdoses. However, states with more severe drug problems may simply be more likely to develop PDMPs. Li et al. (2014) also found that PDMPs did not reduce overdose mortality rates. More recently, Patrick et al. (2016) found that states implementing a prescription drug monitoring program experienced 1.12 fewer opioid-related overdose deaths per 100,000 people annually. They also found that states

that used their programs to monitor controlled substances more actively experienced a larger reduction in fatal overdoses.

Kentucky developed its PDMP, KASPER, in 1999 and it is often regarded as the gold standard for PDMPs (U.S. Substance Abuse and Mental Health Services Administration 2013). Based on estimates from Patrick et al. (2016), KASPER may prevent 50 deaths per year. Assuming the deaths prevented have the same age and gender distribution as overall opioid-related deaths, KASPER may prevent the loss of $25.3 million in present value lifetime earnings and $1.5 million in present value state tax revenue annually. While these estimates provide some indication of the potential benefits of a PDMP, it is important to recognize that researchers have not reached a consensus on whether PDMPs reduce overdose fatalities.

Medically-Assisted Treatment

Medically-assisted treatment (MAT) uses medications along with counseling and social support to help patients reduce opioid use and lead normal lives (Carroll et al. 2018). The CDC indicates that state programs that increase access to MAT, particularly in the criminal justice system and emergency rooms, may be effective ways to reduce opioid overdoses.

The Federal Drug Administration has approved three medications for treating opioid abuse disorder: methadone, buprenorphine, and naltrexone. A large body of research shows that methadone and buprenorphine can be used effectively to treat opioid abuse. While naltrexone appears to have similar potential, patients using oral naltrexone have frequently discontinued treatment. Recent research suggests that injectable naltrexone may not have this disadvantage (Carroll et al. 2018).

Fullerton et al (2014) reviewed past evaluations of MAT with methadone. They found strong evidence indicating that methadone, particularly at sufficient doses, improves treatment retention and reduces illicit opioid use. They also noted that methadone appears to reduce non-opioid illicit drug use, reduce drug-related HIV risk behaviors, and criminal activity. However, the research is not as strong regarding these effects. A similar review found strong evidence that MAT with buprenorphine also improves treatment retention and reduces illicit opioid use (Thomas et al. 2014).

While the research indicates that MAT may improve outcomes for participants, there appears to be relatively little information on whether it improves employment and earnings. Sees et al. (2000) was the only study found to examine employment effects. They compared several outcomes, including employment, between those participating in methadone maintenance treatment (MMT) versus detoxification. While they found that MMT participants were more likely to maintain their treatment and less likely to use heroin after treatment, there was no difference in their employment situations.

Naloxone

According to the CDC, opioids were involved in 67.8 percent of all drug overdose deaths in the nation. Large doses of opioids can be fatal because they disrupt a person's regular breathing patterns. Naloxone, which is also known as Evzio and Narcan, can be used to counteract this

effect, allowing the individual to breathe normally. While naloxone can contribute to symptoms of opioid withdrawal in rare cases, it appears to have little risk of significant side effects (CDC). However, naloxone should be administered as early as possible in order to avoid injury and death. In the past, access to naloxone was restricted. So, an individual suffering from an overdose might not have received naloxone until paramedics arrived or they were brought into an emergency department. In recent years, states and communities have increasingly adopted policies to improve access to naloxone so that it may be administered as early as possible (Gertner et al. 2018).

To improve access, many communities have developed naloxone education and distribution programs for individuals who have a high risk of overdosing on opioids as well as their friends and family members. Training includes how to recognize and respond to an overdose. An evaluation of programs in Baltimore, San Francisco, Chicago, New York, and New Mexico suggested that those who completed training were "as skilled as medical experts in recognizing opioid overdose situations" (Green et al. 2008).

Several research studies provide evidence that naloxone can be an effective tool to reduce opioid overdose deaths. In 2005, a program in Pittsburgh began training people who used its needle exchange site on how to recognize an overdose and administer naloxone. Those completing the training were given naloxone kits. The program surveyed 141 individuals who took the naloxone and later returned for a refill. Of those surveyed, 89 reported that they were involved in at least one overdose in which they used naloxone (Bennet et al. 2011). In 2010, a separate overdose prevention program called Project Lazarus, in Wilkes County, North Carolina, began training physicians on how to recognize patients who might have a high risk of overdose. Patients identified as high risk were offered the opportunity to view a video that included information on how to recognize and respond to an overdose. After viewing the video, patients could receive a free naloxone kit from a community pharmacy. A preliminary evaluation found that overdose deaths in the county decreased from 46.6 per 100,000 in 2009 to 29 per 100,000 in 2010 (Albert et al. 2011). Walley et al. (2013) also found that opioid overdose death rates decreased in communities that established naloxone education and distribution programs. Similarly, Bird et al. (2015) found that distribution of naloxone kits to recently released prisoners in Scotland reduced overdose-related deaths by 20 to 36 percent across a two-year period within this population.

States typically allow health care providers to issue prescriptions only to patients they have examined. While this requirement is intended to protect the patients' health, it may limit access and use of naloxone. To address this concern, states have increasingly enacted various laws to promote greater access to naloxone. Nearly all states, including Kentucky, now allow providers to prescribe naloxone to third-parties, such as the friends and family of individuals who have a high overdose risk (Davis and Carr 2017). Forty states also allow pharmacists to dispense naloxone under a standing order. (With a standing order, an individual does not need to see a physician to obtain a prescription. Instead, a pharmacist may dispense naloxone to an individual who meets certain criteria that is specified in the order.) As of 2016, nine states had granted pharmacists direct authority to dispense naloxone to the public without a prescription (Abouk et al. 2019).

States that adopt these types of naloxone access laws appear to have experienced increased access to naloxone and reduced overdose deaths. Lambdin et al. (2018) found that naloxone access laws facilitate the development of community education and distribution programs. Gertner et al. (2018) found that states allowing standing orders saw naloxone dispensing increase among their Medicaid population. Rees et al. (2017) found that states adopting a naloxone access law experienced a 9 to 11 percent reduction in opioid-related deaths. However, Abouk et al. (2019) found that the type of access law might matter. They estimated that states granting pharmacists direct authority to dispense naloxone experienced a 27 to 34 percent decrease in opioid-related death rates. Providing indirect authority through standing orders or a statewide protocol, however, did not appear to have an effect.

There have been concerns raised regarding potential negative effects associated with increased access to naloxone. A recent working paper by Doleac and Mukherjee (2018) suggests that naloxone could increase use of opioids because it reduces the risk of an overdose death. They found that passing laws to improve access did not reduce mortality rates, but did increase opioid-related emergency room visits and thefts. While Abouk et al. (2019) also found an increase in ER visits, the authors noted that this does not necessarily suggest greater level of abuse. They suggest that ER visits could have increased because those who experience nonfatal overdoses repeatedly use the ER or beause increasing access to naloxone encourages abusers to seek medical assistance.

Several studies suggests that naloxone distribution program are likely to be cost-effective. For example, Coffin and Sullivan (2013) compared the additional costs and improvements in quality adjusted life years (QALYs) that would be associated with distributing naloxone kits to heroin users. They estimated that distributing naloxone would increase lifetime costs by $53 and increase QALYs by 0.119, yielding a cost-effectiveness ratio of $438 per QALY. Generally, lower cost-effectiveness ratios are preferred. Studies often define programs with ratios below $50,000 per QALY as cost-effective. Applying drug-related health care expenditures to the heroin users increased the cost-effectiveness ratio to $2,429 per QALY. Uyei et al. (2017) estimated that naloxone distribution would cost $323 per QALY and that linking it with addiction treatment could actually yield cost savings. Langham et al. (2018) came to similar conclusions. They estimated that distributing naloxone in the United Kingdom would cost the equivalent of $1,093 per QALY gained.

Needle Exchange Programs

The adoption of prescription drug monitoring programs and improvements in prescribing guidelines have helped reduce the amount of prescription opioids available. However, as prescription opioids become harder to obtain, those abusing opioids may turn to illicit forms of opioids such as heroin. Heroin poses additional health risks because users often share syringes, which increases their risk of transmitting infections such as HIV and hepatitis. Needle exchange programs (NEPs) are designed to reduce this risk by providing sterile syringes and removing contaminated syringes from circulation. Many needle exchange programs provide additional services including testing and treatment for infections, providing training and distribution of naloxone, and referring drug users to treatment programs (CDC, Syringe Service Programs (SSP)

FAQs, 2019). According to amfAR (The Foundation for AIDS Research), Kentucky currently has 23 needle exchange programs.

Several studies have examined whether exchange programs reduce infections and health care costs. A 1997 study found that HIV prevalence increased by 5.9 percent per year in cities without NEPs and decreased by 5.8 percent per year in cities with NEPs. Wodak and Cooney (2006) reviewed studies from 1989 to 2002 and concluded that there was compelling evidence that NEPs reduce HIV rates. In 2014, Nguyen et al. estimated that an additional $10 million investment in NEPs in the U.S. would result in 194 fewer HIV infections and avoid $75.8 million in lifetime treatment—a return on investment of 7.58. Kwon et al. (2012) estimated that Australia's investment in NEPs from 2000 to 2012 yielded between $1.30 and $5.50 per dollar invested. Belani and Muennig (2008) estimated that a NEP in New York City saved approximately $1,300 to $3,000 per client in health care and treatment costs.

NEPs may also help opioid users access treatment programs to address their addictions (Wodak and Cooney 2006). Braback et al. (2018) followed a sample of individuals who were referred to opioid treatment after they used a NEP in Sweden. They found that while those referred to treatment reported lower quality of life than the general population, they experienced significant improvements three months after being referred to treatment. Brooner et al. (1998) compared drug treatment patients in Baltimore who were referred either from a needle exchange program or standard avenues. While those who were referred through the needle exchange programs had a higher initial rate of drug use, they experienced similar reductions in drug use one month after treatment. Both studies suggest that NEPs can be an effective way to help opioid abusers access treatment.

Section 5: Conclusions

Researchers have shown that opioid abuse imposes significant costs on society. Government agencies charged with providing health, social, and criminal justice services all face significant fiscal pressures in dealing with the crisis. This analysis examines how opioid abuse contributes to these fiscal pressures by affecting Kentucky's workforce, earnings, and state tax revenues.

Opioid abuse mainly affects the state's workforce by reducing labor force participation, contributing to greater numbers of fatal drug overdoses, and increasing absenteeism and presenteeism. Opioid abuse is estimated to reduce employment by 23,100 to 55,200 workers, resulting in $1.0 to $2.8 billion in lost earnings and $63 to $169 million in reduced state tax revenues per year. Absenteeism and presenteeism were estimated to cost the state approximately $240 million in lost productivity and up to $14.4 million in lost tax revenue annually.

In addition to the reduced employment, there were 1,374 opioid-related deaths among Kentucky residents under the age of 65 in 2016. In the absence of opioid abuse, many of these individuals could have continued to work. The 1,374 deaths in 2016 were estimated to cost nearly $700 million in lifetime earnings and $42 million in lifetime tax revenue. The fiscal impact for any single year reflects deaths that occurred over previous years. From 2007 to 2016, there were 9,800 opioid-related deaths among Kentucky residents younger than 65 years. These deaths were estimated to cost between $9.3 million and $18.6 million in lost state tax revenue in 2017.

State revenues lost annually to opioid abuse range from $86.7 million to $202 million. This represents 0.8 and 1.8 percent of the state's general fund revenues in FY 2019. This figure does not include the additional expenditures state agencies incur due to opioid abuse such as caring for foster children and treating individuals enrolled in Medicaid.

Table 6
Annual State Tax Revenues Lost from Opioid Abuse
($ millions)

Type of Workforce Impact	Low Estimates	High Estimates
Reduced Labor Force Participation	$63.0	$169.0
Premature Deaths (2007 to 2016)	$9.3	$18.6
Increased Absenteeism & Presenteeism	$14.4	$14.4
Total	**$86.7**	**$202.0**

There is strong evidence suggesting that state level strategies such as prescription drug monitoring programs and medically-assisted treatment can help, although the economic impacts are difficult to quantify. Prescription drug monitoring programs are associated with lower rates of opioid abuse and may lower the number of fatal drug overdoses. Medically-assisted treatments have been shown to help patients maintain their treatment and reduce the use of illicit opioids. There is some evidence to suggest that medically-assisted treatment might also reduce non-opioid illicit drug use, drug-related HIV risk behaviors, and criminal activity. Needle exchange programs are associated with reductions in reduced infections of HIV and reduced health care costs. There appear to be substantial social benefits to these types of programs. These benefits might include improvements in employment and earnings as well, but at this point, there appears to be little research addressing this issue.

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