**FINAL REPORT**

# Appalachian Diseases of Despair

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NORC's Institutional Review Board approved all data analysis, reporting, and subsequent publications. The views expressed are those of the authors and not necessarily those of ARC or NORC.

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# Introduction

The Appalachian Region, as defined in the Appalachian Regional Commission's (ARC) authorizing legislation, is a 205,000-square-mile region that spans the Appalachian Mountains from southern New York to northern Mississippi. It includes all of West Virginia and parts of 12 other states: Alabama, Georgia, Kentucky, Maryland, Mississippi, New York, North Carolina, Ohio, Pennsylvania, South Carolina, Tennessee, and Virginia. The Region includes 420 counties and eight independent cities in 13 states and has a population of 25 million people.[1]

Compared to the rest of the nation, the Appalachian Region faces disparities related to educational attainment, employment, income, and certain health outcomes. Prior work conducted by NORC has demonstrated disparities in mortality within Appalachia, particularly by levels of rurality.[2,3] Appalachia's household income is 82.5 percent of the U.S. average, and 16 percent of Appalachians live below the poverty level.[4] Certain Appalachian subregions experience greater disparities than others; for example, household income and bachelor's degree attainment are lowest in Central Appalachia.[4,5]

In 2008, NORC and ETSU conducted a study on behalf of ARC titled, "An Analysis of Mental Health Services and Substance Abuse Disparities and Access to Treatment Services in the Appalachian Region," which found that treatment admission rates for primary abuse of opiates and synthetics were higher in Appalachia than the rest of the nation and were growing at a faster pace.[6] In 2017, ARC commissioned NORC to investigate "diseases of despair" in Appalachia. At the time, research conducted by health economists Anne Case and Angus Deaton had begun to focus on increasing morbidity and mortality from three main causes: alcohol, prescription drug, and illegal drug overdose; suicide; and alcoholic liver disease/cirrhosis of the liver. These have been referred to as "deaths of despair" or diseases of despair.[7]

The 2017 Appalachian Diseases of Despair study was based on 2015 mortality data. At that time, the United States was seeing a dramatic rise in overdose deaths from synthetic opioids, particularly those involving illicitly manufactured fentanyl.[8] ARC commissioned NORC and ETSU to update the prior diseases of despair study using 2018 data, to determine changes between 2015 and 2018.

# Methods

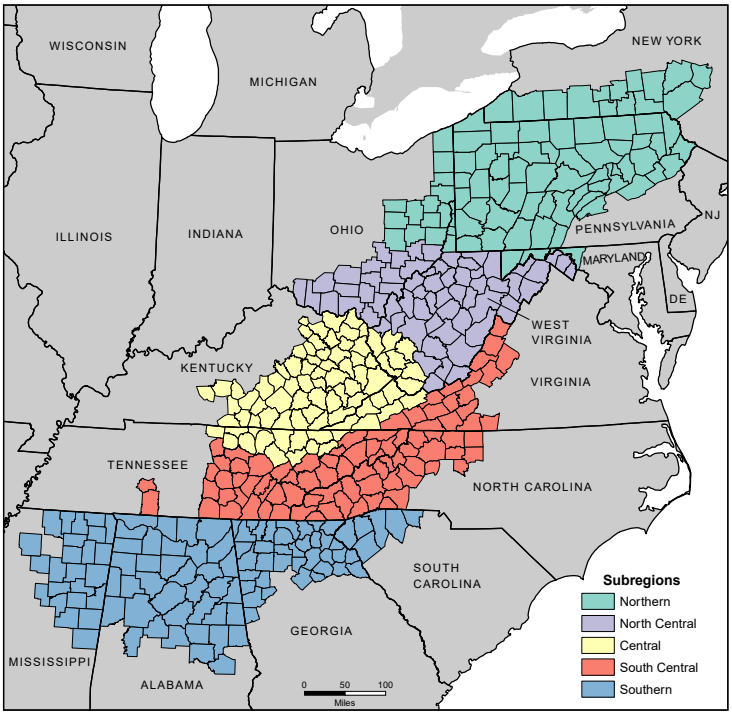
This report presents 2018 mortality data from the Multiple Cause of Death database, which is publicly available through CDC Wide-ranging Online Data for Epidemiologic Research (CDC WONDER), an online data system that provides access to data from the CDC National Center for Health Statistics (NCHS) National Vital Statistics System (NVSS).[9] NVSS collects and presents U.S. resident data for the aggregate of 50 states, New York City, and the District of Columbia, as well as for each individual state. The Multiple Cause of Death database provides the underlying cause of death, as well as up to 20 additional multiple causes, as reported on an individual's death certificate by a physician, coroner, and/or medical examiner.[10] Deaths are coded to the International Classification of Disease Tenth Revision (ICD-10) codes. For this report, we included the ICD-10 codes referenced by Case and Deaton, reflecting underlying cause of death from each of the three diseases of despair: alcohol, prescription drug, and illegal drug overdose; suicide; and alcoholic liver disease/cirrhosis of the liver.[7] To determine the percentage of alcohol, prescription drug, and illegal drug overdose deaths attributed to opioids, we used the multiple cause-of-death ICD-10 codes that specify the type of drug causing the overdose.[11] Appendix A provides the underlying cause-of-death ICD-10 codes used to identify the disease of despair, and the multiple cause-of-death ICD-10 codes that identify overdoses caused by opioids.

Analyses use age-adjusted mortality rates and focus on the population ages 15–64; however, select analyses report mortality rates by age group (10-year increments between ages 15–64). If the Appalachian counties in a specific state had fewer than 20 deaths, the state-specific mortality rate for that disease of despair is considered unreliable. The few instances of unreliable data are noted in the findings. This study aimed to detect differences in the mortality rates from diseases of despair between Appalachia and the non-Appalachian United States (the rest of the country, excluding Appalachia), in addition to differences by age groups and gender. Statistical significance was assessed at the 0.05 level using two-sided significance tests ($z$-tests).

Appalachian rates were further analyzed by subregion, county economic status, and levels of rurality. Appalachian subregions represent contiguous geographies of relatively homogeneous characteristics (topography, demographics, economics, and transportation) and include Northern, North Central, Central, South Central, and Southern Appalachia (see Exhibit 1). ARC's economic classifications rely on an index of three economic indicators (three-year unemployment rate, per capita market income, and poverty rate). Counties are then designated based on the index as distressed, at-risk, transitional, competitive, or attainment.[12] For these analyses, counties were classified as distressed or non-distressed. Lastly, for rurality, we used ARC designations of "metropolitan counties" (counties that include large metropolitan centers of one million population or greater and those with metropolitan centers of less than one million

population), and "nonmetropolitan counties" (nonmetro counties adjacent to large metros, those adjacent to small metros, and rural counties). These designations are based on a simplification of the U.S. Department of Agriculture's (USDA) Economic Research Services (ERS) 2013 Urban Influence Codes (UIC).[13]

## Exhibit 1. Appalachian subregions



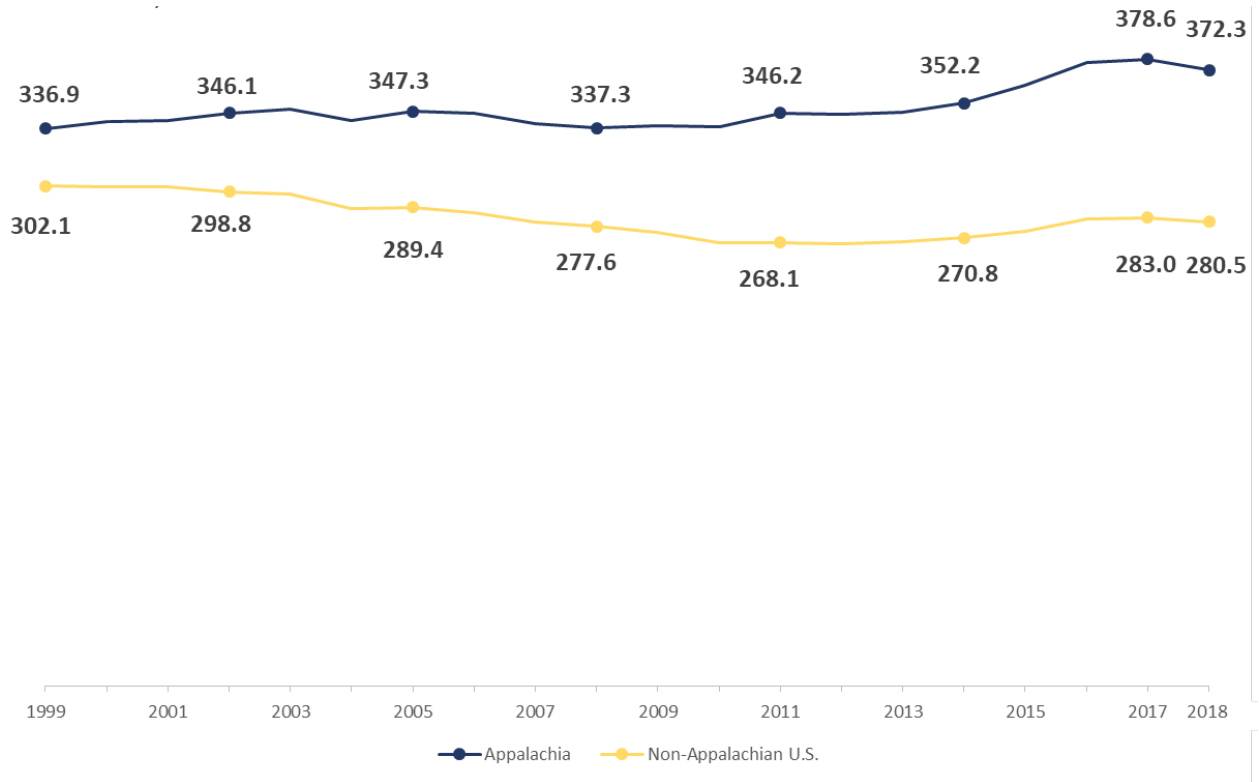

Data source: Appalachian Regional Commission, created November 2009.

# Findings

## Overall Mortality

The all-cause mortality rate (overall mortality) among individuals ages 15–64 in the non-Appalachian U.S. steadily declined between 1999 and 2012, before increasing between 2012 and 2017 (see Exhibit 2). Between 1999 and 2012, the overall mortality rate in the non-Appalachian U.S. *decreased* by 11.5 percent, while the overall mortality rate in the Appalachian Region *increased* by 2.6 percent—resulting in an increasing disparity between the Region and the rest of the nation. Between 2012 and 2017, the all-cause mortality rate in the non-Appalachian U.S. increased by 5.8 percent. During this same period, the overall mortality rate in the Appalachian Region increased by 9.5 percent. This rise in all-cause mortality rate between 2012 and 2017 coincides with the surge in opioid overdose deaths in the United States.

**Exhibit 2.** All-cause annual mortality rates, ages 15–64, by region (1999–2018)‡*



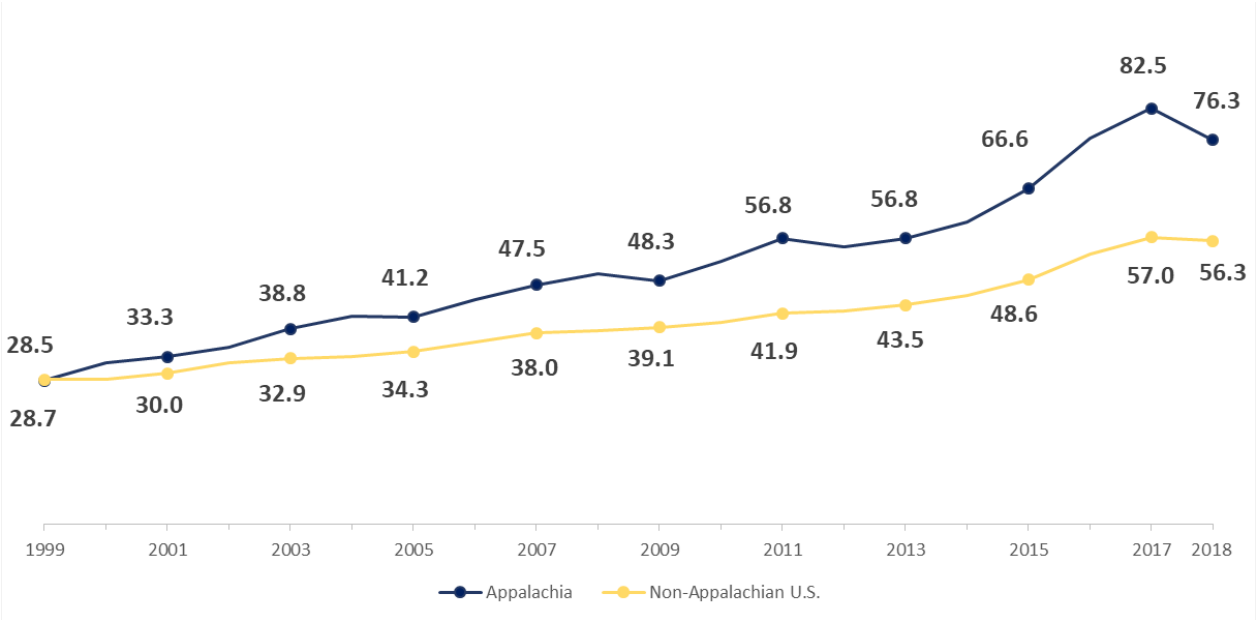

‡ Rates are presented as deaths per 100,000 population. Rates are age adjusted.
* For all years, the Appalachian rate is significantly different from the non-Appalachian U.S. rate, $p \leq 0.05$.
Source: Mortality Rates and Standard Errors provided by Centers for Disease Control and Prevention, National Center for Health Statistics.
Accessed at http://wonder.cdc.gov/mcd-icd10.html.

Between 2017 and 2018, both the non-Appalachian U.S. and the Appalachian Region saw the first decline in all-cause mortality rate since 2011 to 2012. In the non-Appalachian U.S., the all-cause mortality rate declined from 283.0 deaths per 100,000 in 2017 to 280.5 deaths per 100,000 in 2018 (a 0.9 percent decrease). By comparison, the all-cause mortality rate in the Appalachian Region declined from 378.6 deaths per 100,000 in 2017 to 372.3 deaths per 100,000 in 2018 (a 1.7 percent decrease). The decline in all-cause mortality rate is likely driven by declines in drug overdose mortality during this period.

## Diseases of Despair: Comparisons between Appalachia and the non-Appalachian United States

Exhibit 3 compares the burden from diseases of despair between the Appalachian Region and the non-Appalachian U.S. from 1999 to 2018. The disparity between the Appalachian Region and the rest of the nation continued to grow between 1999 and 2017. In 1999, the diseases of despair mortality rate was not statistically different between the non-Appalachian U.S. and the Appalachian Region. By 2007, the mortality rate in the Appalachian Region was 25 percent higher than the non-Appalachian U.S. In 2015, the difference had grown to 37 percent. The disparity between the Appalachian Region and the non-Appalachian U.S. reached its widest gap in 2017, when the diseases of despair mortality rate was 45 percent higher in Appalachia than the non-Appalachian U.S. The gap began to narrow in 2018, as the diseases of despair mortality rate was 36 percent higher in the Appalachian Region. The mortality rate among individuals ages 15–64 was 76.3 per 100,000 in Appalachia, compared to 56.3 deaths per 100,000 in the non-Appalachian U.S. The diseases of despair mortality rate declined by 7.5 percent in the Appalachian Region between 2017 and 2018.

**Exhibit 3**. Diseases of despair annual mortality rates, ages 15–64, by region (1999–2018)‡*




‡ Rates are presented as deaths per 100,000 population. Rates are age adjusted.

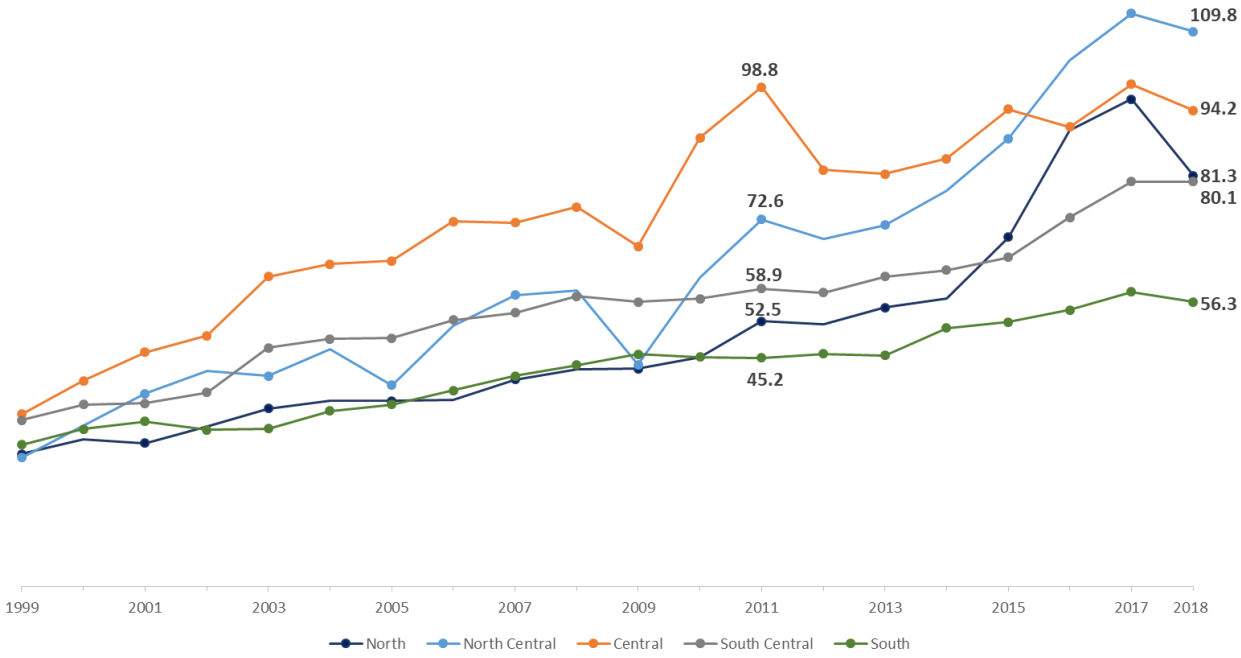
* In all years except 1999, the Appalachian rate is significantly different from the non-Appalachian U.S. rate, $p \leq 0.05$.

Source: Mortality Rates and Standard Errors provided by Centers for Disease Control and Prevention, National Center for Health Statistics.

Accessed at http://wonder.cdc.gov/mcd-icd10.html.

Exhibit 4 compares the diseases of despair mortality rate trends for the five subregions of Appalachia and shows how the rate has increased across the Region over the past two decades. Between 2011 and 2018, the diseases of despair mortality rate in North Central Appalachia increased from 72.6 deaths per 100,000 to 109.8 deaths per 100,000, a 51 percent increase. Northern Appalachia saw a similar increase between 2011 and 2017, before declining to 81.3 deaths per 100,000 in 2018. Between 1999 and 2015, Central Appalachia had the highest diseases of despair mortality in the Region. Central Appalachia experienced a decline in mortality between 2011 and 2012, and in 2016 was surpassed by North Central Appalachia for having the highest mortality rate. The diseases of despair mortality rate has increased steadily in South Central Appalachia since 1999, with a steeper increase beginning in 2015. South Appalachia has had the slowest rate of increase for diseases of despair mortality. In 2018, the diseases of despair mortality rate in South Appalachia was approximately half the mortality rate in North Central Appalachia.

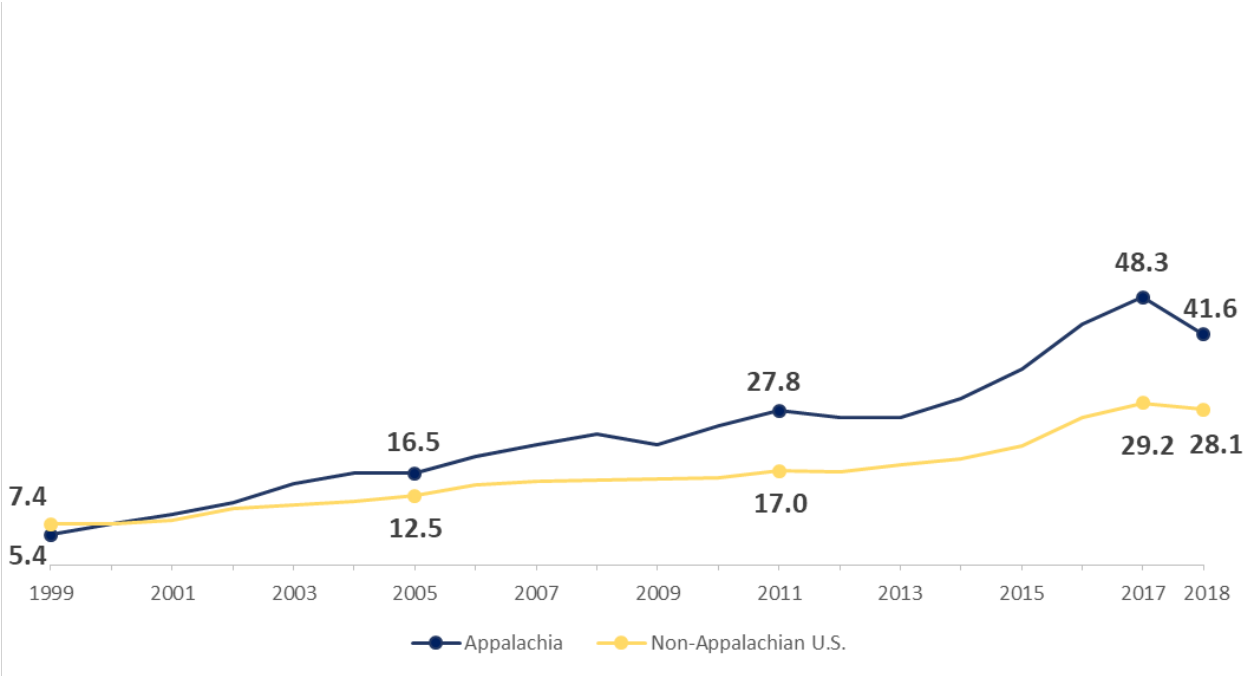
**Exhibit 4**. Diseases of despair annual mortality rates, ages 15–64, by Appalachian subregion (1999–2018)‡




‡ Rates are presented as deaths per 100,000 population. Rates are age adjusted.
Source: Mortality Rates and Standard Errors provided by Centers for Disease Control and Prevention, National Center for Health Statistics.
Accessed at http://wonder.cdc.gov/mcd-icd10.html.

Exhibit 5 shows the trend in overdose mortality rates between 1999 and 2018. In 1999, the overdose mortality rate was low for both the non-Appalachian U.S. and the Appalachian Region, with the rate slightly higher in the non-Appalachian U.S. By 2011, the Appalachian Region overdose mortality rate was five times as high as the rate in 1999, increasing to 27.8 deaths per 100,000 population. In the non-Appalachian U.S., the overdose mortality rate was more than twice as high in 2011 than 1999, rising to 17.0 deaths per 100,000 population. In 2011, the overdose mortality rate in the Appalachian Region was 64 percent higher than the non-Appalachian U.S. By 2017, the overdose mortality rate had grown in both the Appalachian Region and the non-Appalachian U.S., with both reaching their peak overdose mortality rates. The overdose mortality rate in the Appalachian Region was 48.3 deaths per 100,000 population, 65 percent higher than the rate of 29.2 deaths per 100,000 population in the non-Appalachian U.S. In 2018, both the Appalachian Region and the non-Appalachian U.S. experienced a decline in the overdose mortality rate. The overdose mortality rate declined by 14 percent in the Appalachian Region between 2017 and 2018, and 3.8 percent in the non-Appalachian U.S.

**Exhibit 5**. Overdose annual mortality rates, ages 15–64, by region (1999–2018)‡*

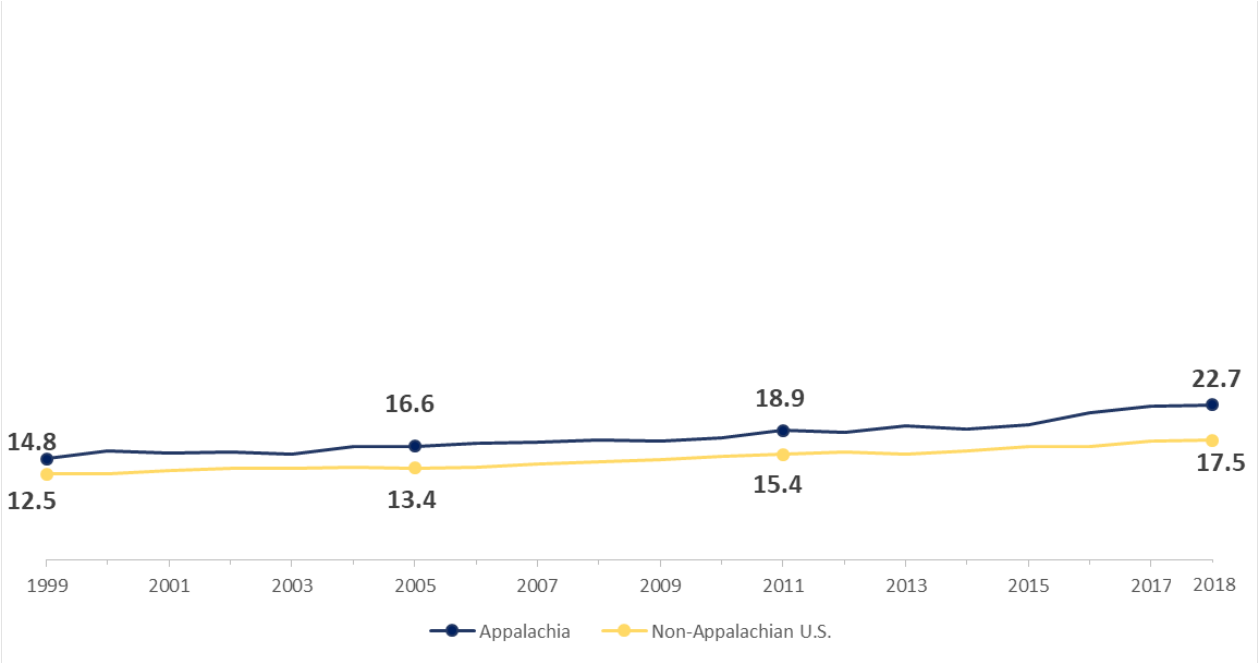



‡ Rates are presented as deaths per 100,000 population. Rates are age adjusted.
* In all years except 2000, the Appalachian rate is significantly different from the non-Appalachian U.S. rate, $p \leq 0.05$.
Source: Mortality Rates and Standard Errors provided by Centers for Disease Control and Prevention, National Center for Health Statistics.
Accessed at http://wonder.cdc.gov/mcd-icd10.html.

Exhibit 6 shows the trends in suicide mortality rates between 1999 and 2018 for the Appalachian Region and the non-Appalachian U.S. between 1999 and 2018. In all years between 1999 and

2018, the suicide mortality rate in the Appalachian Region was statistically higher than the rate in the non-Appalachian U.S. The suicide mortality rate in the Appalachian Region increased by 53 percent over the period, while the suicide mortality rate in the non-Appalachian U.S. increased by 40 percent.

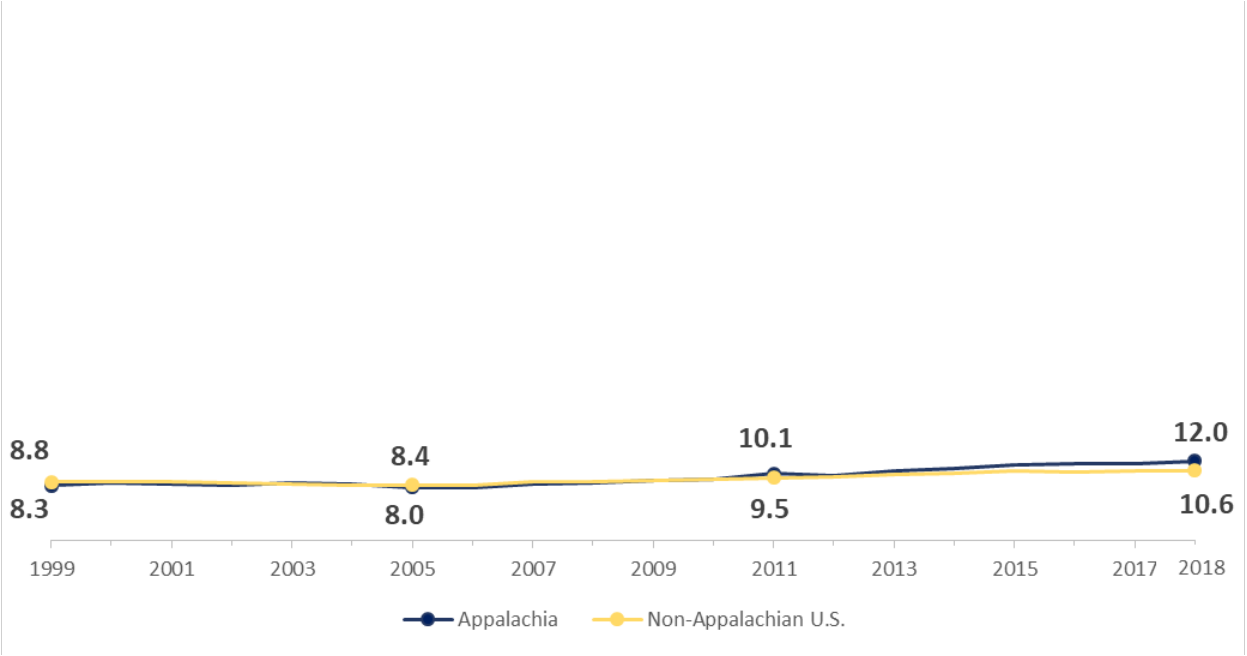
**Exhibit 6.** Suicide annual mortality rates, ages 15–64, by region (1999–2018)‡*




‡ Rates are presented as deaths per 100,000 population. Rates are age adjusted.
* In all years, the Appalachian rate is significantly different from the non-Appalachian U.S. rate, $p \leq 0.05$.
Source: Mortality Rates and Standard Errors provided by Centers for Disease Control and Prevention, National Center for Health Statistics.
Accessed at http://wonder.cdc.gov/mcd-icd10.html.

As shown in Exhibit 7, the liver disease mortality rate has remained relatively stable, with minimal difference between the Appalachian Region and the non-Appalachian U.S. between 1999 and 2018. In 1999, the liver disease mortality rate among the population ages 15–64 was 8.8 deaths per 100,000 in the non-Appalachian U.S. and 8.3 deaths per 100,000 population in the Appalachian Region. By 2018, these rates had increased to 10.6 deaths per 100,000 population in the non-Appalachian U.S. and 12.0 deaths per 100,000 population in the Appalachian Region.

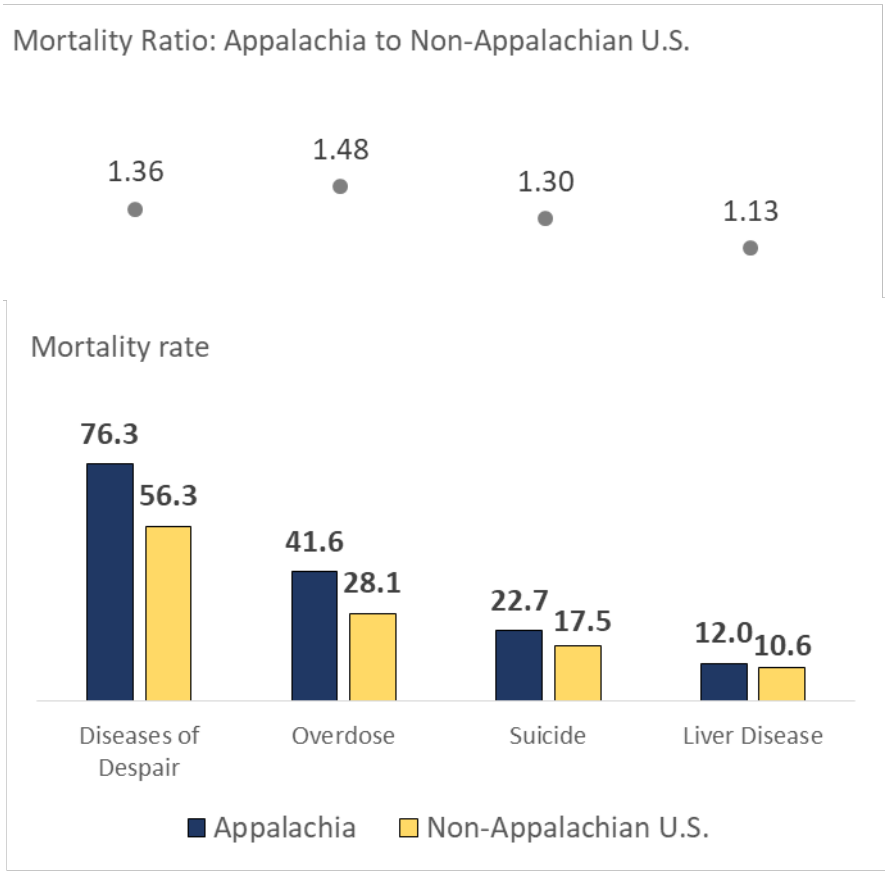
**Exhibit 7.** Liver disease annual mortality rates, ages 15–64, by region (1999–2018)‡*




‡ Rates are presented as deaths per 100,000 population. Rates are age adjusted.
* In 1999, 2002, 2005, 2011, and 2013–2018, the Appalachian rate is significantly different from the non-Appalachian U.S. rate, $p \leq 0.05$.
Source: Mortality Rates and Standard Errors provided by Centers for Disease Control and Prevention, National Center for Health Statistics.
Accessed at http://wonder.cdc.gov/mcd-icd10.html.

Exhibit 8 compares the burden from each disease of despair between the Appalachian Region and the non-Appalachian U.S. in 2018. Among the population ages 15–64 in Appalachia, there were 6,483 overdose deaths, 3,746 suicide deaths, and 2,395 alcoholic liver disease/cirrhosis deaths. Of the three diseases of despair, the overall burden in Appalachia and the disparity between Appalachia and the non-Appalachian U.S. was most notable for overdose mortality. The overdose mortality rate among individuals ages 15–64 was 48 percent higher in the Appalachian Region compared to the rest of the nation: There were 41.6 deaths per 100,000 population in the Region, compared to 28.1 deaths per 100,000 population in the non-Appalachian U.S. The suicide rate was 30 percent higher and the liver disease mortality rate was 13 percent higher in Appalachia than the non-Appalachian U.S. All differences between the Appalachian Region and the non-Appalachian U.S. were statistically significant.

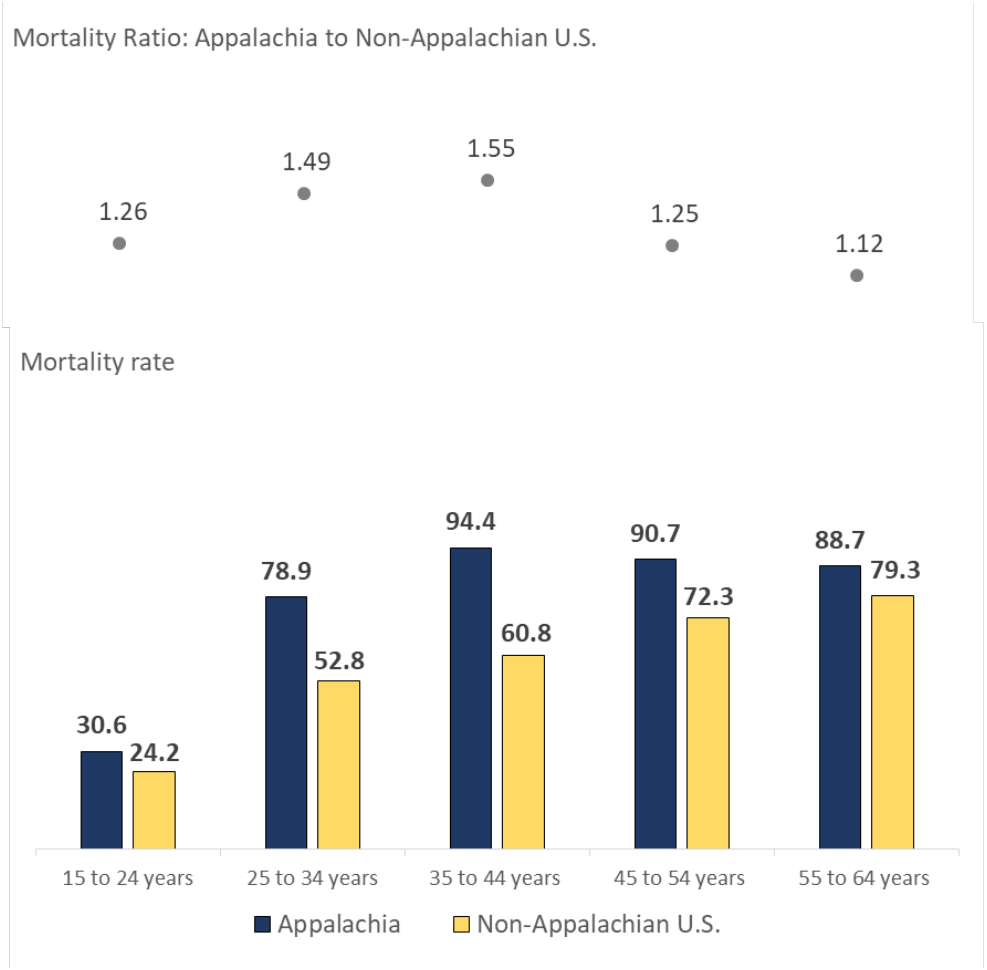
**Exhibit 8**. Diseases of despair mortality rates, ages 15–64, by disease and region (2018)‡*




‡ Rates are presented as deaths per 100,000 population. Rates are age adjusted.
* For all diseases, the Appalachian rate is significantly different from the non-Appalachian U.S. rate, $p \leq 0.05$.
Source: Mortality Rates and Standard Errors provided by Centers for Disease Control and Prevention, National Center for Health Statistics.
Accessed at http://wonder.cdc.gov/mcd-icd10.html.

There are differences in mortality from the diseases of despair by age group, as shown in Exhibit 9. The Appalachian Region experienced higher rates of mortality than the non-Appalachian U.S. for all 10-year age ranges between 15 and 64. The mortality rate for the 25–34 age group in Appalachia was 49 percent higher than the rate in the non-Appalachian U.S. and 55 percent higher for Appalachians in the 35–44 age group. The burden was greatest among individuals ages 35–44, where the mortality rate was 94.4 deaths per 100,000 population. Among individuals ages 25–54, traditionally considered the "working-age population," the diseases of despair mortality rate was 43 percent higher in the Appalachian Region (88.4 deaths per 100,000 population, compared to 61.9 deaths per 100,000 in the non-Appalachian U.S.) For all age groups, the difference between the mortality rate in the Appalachian Region and the non-Appalachian U.S. was statistically significant.

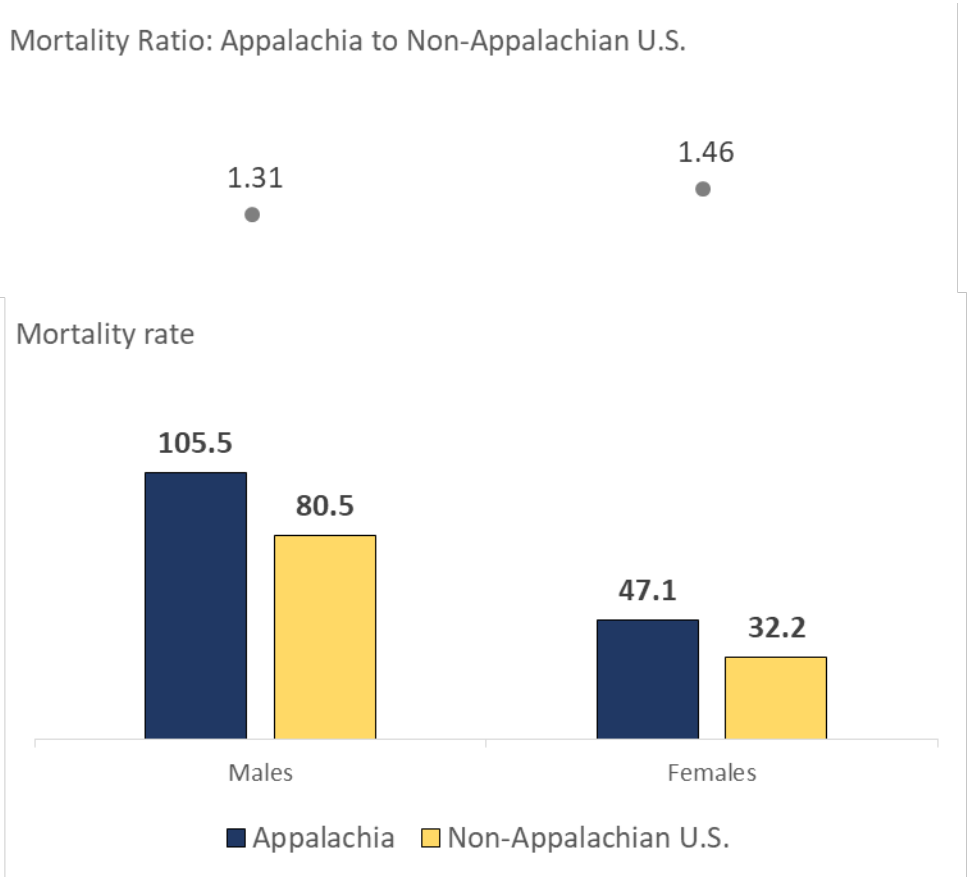
**Exhibit 9**. Diseases of despair mortality rates, ages 15–64, by age and region (2018)‡*




‡ Rates are presented as deaths per 100,000 population. Rates are crude mortality rates for each age group.
* For all age groups, Appalachian rate is significantly different from the non-Appalachian U.S. rate, $p \leq 0.05$.
Source: Mortality Rates and Standard Errors provided by Centers for Disease Control and Prevention, National Center for Health Statistics.
Accessed at http://wonder.cdc.gov/mcd-icd10.html.

In 2018, the burden of mortality attributed to diseases of despair was higher for males than females, as shown in Exhibit 10. In Appalachia, among males ages 15–64, the diseases of despair mortality rate was 105.5 deaths per 100,000, compared to 47.1 deaths per 100,000 population among females ages 15–64. However, the disparity between the Appalachian Region and non-Appalachian U.S. was greater for females. Specifically, the diseases of despair mortality rate was 46 percent higher for females in the Appalachian Region than females in the non-Appalachian U.S., compared to 31 percent higher for males.

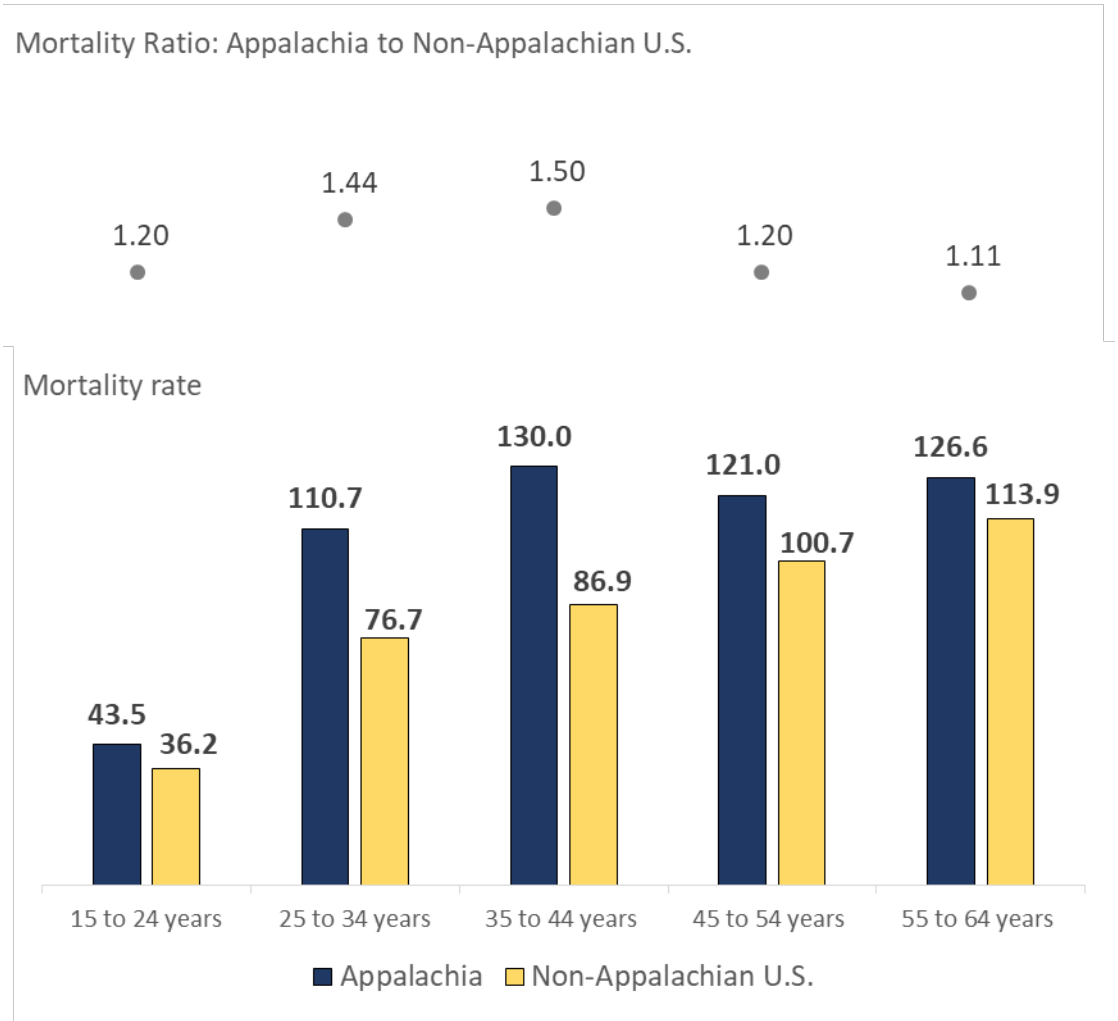
**Exhibit 10.** Diseases of despair mortality rates, ages 15–64, by gender and region (2018)‡*




‡ Rates are presented as deaths per 100,000 population. Rates are age adjusted.
* For both genders, Appalachian rate is significantly different from the non-Appalachian U.S. rate, $p \leq 0.05$.
Source: Mortality Rates and Standard Errors provided by Centers for Disease Control and Prevention, National Center for Health Statistics.
Accessed at http://wonder.cdc.gov/mcd-icd10.html.

Exhibit 11 shows diseases of despair mortality for males, by 10-year age groups. Among males ages 35–44, the diseases of despair mortality rate was 130.0 deaths per 100,000 in the Appalachian Region, which was 50 percent higher than the rate in the non-Appalachian U.S. For males in each age group, the difference between the mortality rate in the Appalachian Region and the non-Appalachian U.S. was statistically significant.

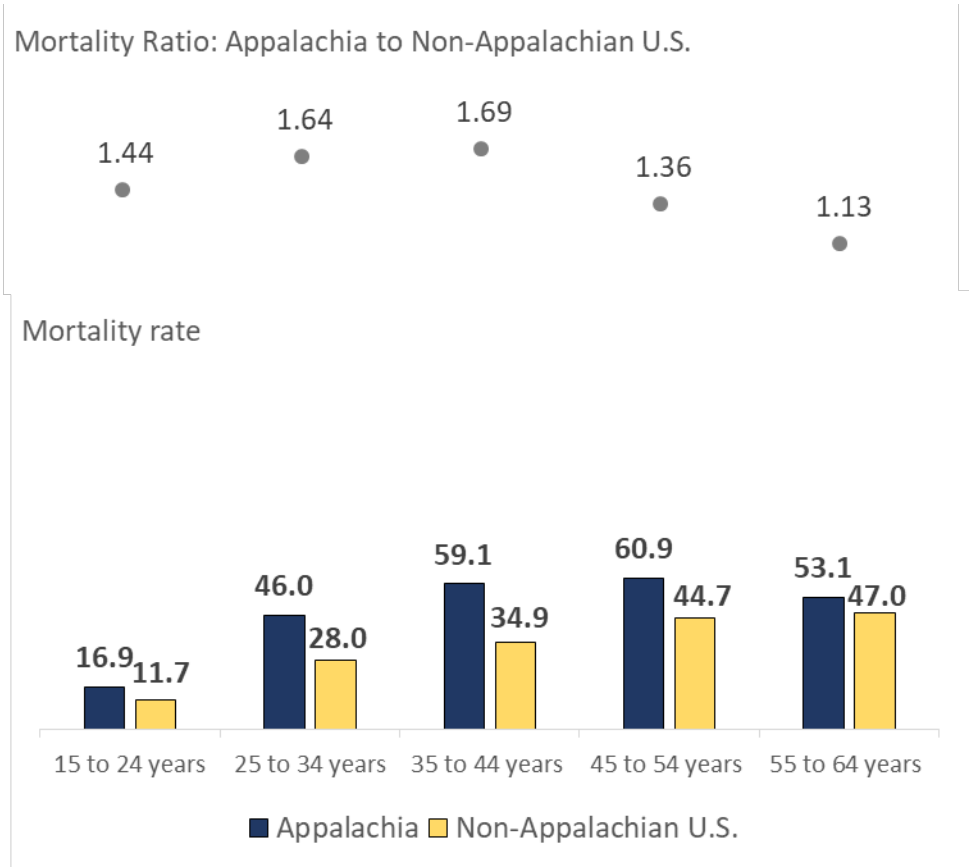
**Exhibit 11.** Diseases of despair mortality rates for males, ages 15–64, by age and region (2018)‡*




‡ Rates are presented as deaths per 100,000 population. Rates are crude mortality rates for each age group.
* For all age groups, Appalachian rate is significantly different from the non-Appalachian U.S. rate, $p \leq 0.05$.
Source: Mortality Rates and Standard Errors provided by Centers for Disease Control and Prevention, National Center for Health Statistics.
Accessed at http://wonder.cdc.gov/mcd-icd10.html.

While the overall burden was lower among females than males for the combined diseases of despair mortality, the disparity between Appalachia and the non-Appalachian U.S. was larger than the disparity for males, as shown in Exhibit 12. Specifically, the mortality rate was 69 percent higher for women ages 35–44 and 64 percent higher for women ages 25–34 in Appalachia compared to the non-Appalachian U.S. For females of all ages, the difference between the mortality rate in the Appalachian Region and the non-Appalachian U.S. was statistically significant.

**Exhibit 12.** Diseases of despair mortality rates for females, ages 15–64, by age and region (2018)‡*




‡ Rates are presented as deaths per 100,000 population. Rates are crude mortality rates for each age group.
* For all age groups, Appalachian rate is significantly different from the non-Appalachian U.S. rate, $p \leq 0.05$.
Source: Mortality Rates and Standard Errors provided by Centers for Disease Control and Prevention, National Center for Health Statistics.
Accessed at http://wonder.cdc.gov/mcd-icd10.html.

## Diseases of Despair: State Comparisons (Appalachia versus non-Appalachia)

States in the Appalachian Region experienced differences in diseases of despair mortality rates between the Appalachian and non-Appalachian portions of the state. Exhibit 13 shows the percentage difference between the mortality rates from diseases of despair in the Appalachian portion of each state, compared to the non-Appalachian portion. West Virginia is omitted because the entire state is included in the Appalachian Region. Appalachian Maryland has the greatest disparity, as the diseases of despair mortality rate was 53 percent higher than the non-Appalachian portion of the state. In Virginia, Alabama, North Carolina, New York, and Tennessee, the diseases of despair mortality rate in the Appalachian portion of the state was at least 33 percent higher than the non-Appalachian portion. Mississippi was the only state where the non-Appalachian counties had a higher mortality rate from diseases of despair than the Appalachian counties. In all states where the diseases of despair mortality rate was higher in the Appalachian portion of the state, this difference was statistically significant.

**Exhibit 13.** Diseases of despair mortality rates, comparing Appalachian and non-Appalachian portions of states, ages 15–64, by disease and state (2018)‡

| | Diseases of Despair—Total | | |
|---|---|---|---|
| | App | Non-App | % Difference |
| **Maryland** | 108.1 * | 70.8 | 53% |
| **Tennessee** | 87.0 * | 63.9 | 36% |
| **New York** | 57.2 * | 42.2 | 36% |
| **North Carolina** | 75.3 * | 55.7 | 35% |
| **Alabama** | 62.1 * | 46.3 | 34% |
| **Virginia** | 64.2 * | 48.4 | 33% |
| **Kentucky** | 92.2 * | 76.3 | 21% |
| **Ohio** | 95.4 * | 79.1 | 21% |
| **South Carolina** | 71.7 * | 61.2 | 17% |
| **Georgia** | 48.3 * | 42.7 | 13% |
| **Pennsylvania** | 82.4 * | 74.3 | 11% |
| **Mississippi** | 39.7 | 44.1 | -10% |
| **West Virginia** | 116.5 | N/A | N/A |

‡ Rates are presented as deaths per 100,000 population. Rates are age adjusted.

* Appalachian rate is significantly different than the non-Appalachian rate for the same disease, $p \leq 0.05$.

Source: Mortality Rates and Standard Errors provided by Centers for Disease Control and Prevention, National Center for Health Statistics.

Accessed at http://wonder.cdc.gov/mcd-icd10.html.

Exhibit 14 shows the mortality rates for the individual diseases of despair comparing Appalachian and non-Appalachian counties.

**Exhibit 14.** Individual diseases of despair mortality rates, comparing Appalachian and non-Appalachian portions of states, ages 15–64, by disease and state (2018)‡

| | Overdose | | Suicide | | Alcoholic Liver Disease/Cirrhosis | |
|---|---|---|---|---|---|---|
| | App | Non-App | App | Non-App | App | Non-App |
| **Alabama** | 27.1 * | 16.6 | 22.8 * | 18.6 | 12.3 | 11.0 |
| **Georgia** | 18.9 | 17.1 | 20.8 * | 16.8 | 8.6 | 8.8 |
| **Kentucky** | 51.4 * | 43.8 | 22.7 | 21.7 | 18.1 * | 10.7 |
| **Maryland** | 74.9 * | 52.8 | 20.7 * | 12.2 | 12.4 * | 5.8 |
| **Mississippi** | 10.1 * | 16.9 | 18.0 | 16.4 | 11.7 | 10.7 |
| **New York** | 29.2 | 26.0 | 17.6 * | 10.2 | 10.3 * | 6.1 |
| **North Carolina** | 39.2 * | 30.1 | 22.1 * | 16.3 | 14.0 * | 9.3 |
| **Ohio** | 59.7 * | 50.5 | 23.9 * | 18.7 | 11.8 * | 10.0 |
| **Pennsylvania** | 51.2 | 52.0 | 22.5 * | 16.2 | 8.6 * | 6.2 |
| **South Carolina** | 37.2 * | 30.1 | 22.3 | 19.0 | 12.3 | 12.2 |
| **Tennessee** | 46.4 * | 33.9 | 23.7 * | 19.1 | 16.9 * | 10.9 |
| **Virginia** | 24.0 | 23.4 | 25.2 * | 17.0 | 15.0 * | 8.1 |
| **West Virginia** | 74.4 | N/A | 27.9 | N/A | 14.2 | N/A |

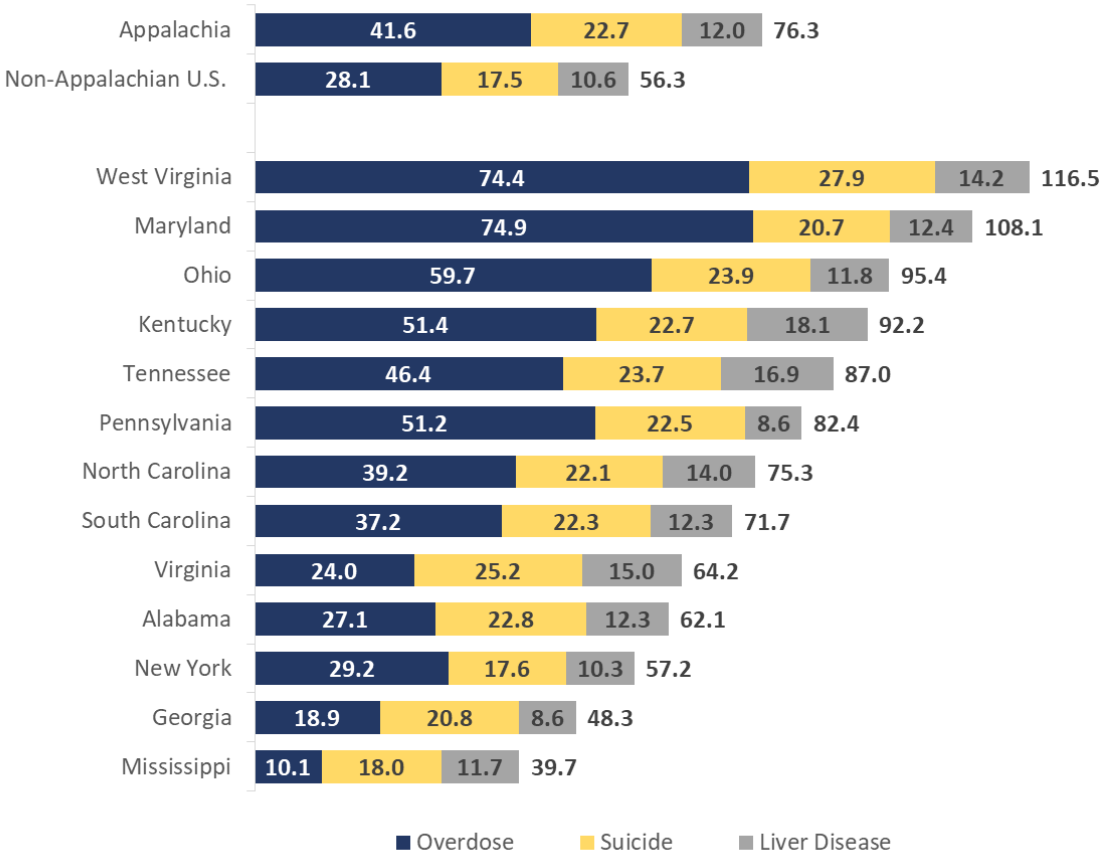
‡ Rates are presented as deaths per 100,000 population. Rates are age adjusted.
* Appalachian rate is significantly different than the non-Appalachian rate for the same disease, $p \leq 0.05$.
Source: Mortality Rates and Standard Errors provided by Centers for Disease Control and Prevention, National Center for Health Statistics.
Accessed at http://wonder.cdc.gov/mcd-icd10.html.

## Diseases of Despair: Disparities within Appalachia

While the Appalachian Region as a whole experiences disparities attributable to diseases of despair compared to the rest of the United States, there are subregions within Appalachia where the burden is most concentrated. The following findings describe the disparities within the Appalachian Region by subregion, county economic status, and rurality.

Exhibit 15 shows the mortality rate for each individual disease of despair by state. For each state, only the mortality rate for the Appalachian portion is shown. For all diseases of despair, West Virginia and Appalachian Maryland had the highest mortality rate of all Appalachian states at 116.5 deaths per 100,000 population and 108.1 deaths per 100,000 population, respectively. The Appalachian portions of Mississippi, Georgia, and New York had the lowest combined mortality rates from diseases of despair, and Appalachian Mississippi and Georgia were the only states with a diseases of despair mortality rate lower than the overall non-Appalachian U.S. rate. In Appalachian Maryland, West Virginia, Appalachian Ohio, and Appalachian Pennsylvania, at least 60 percent of diseases of despair deaths were due to overdose.

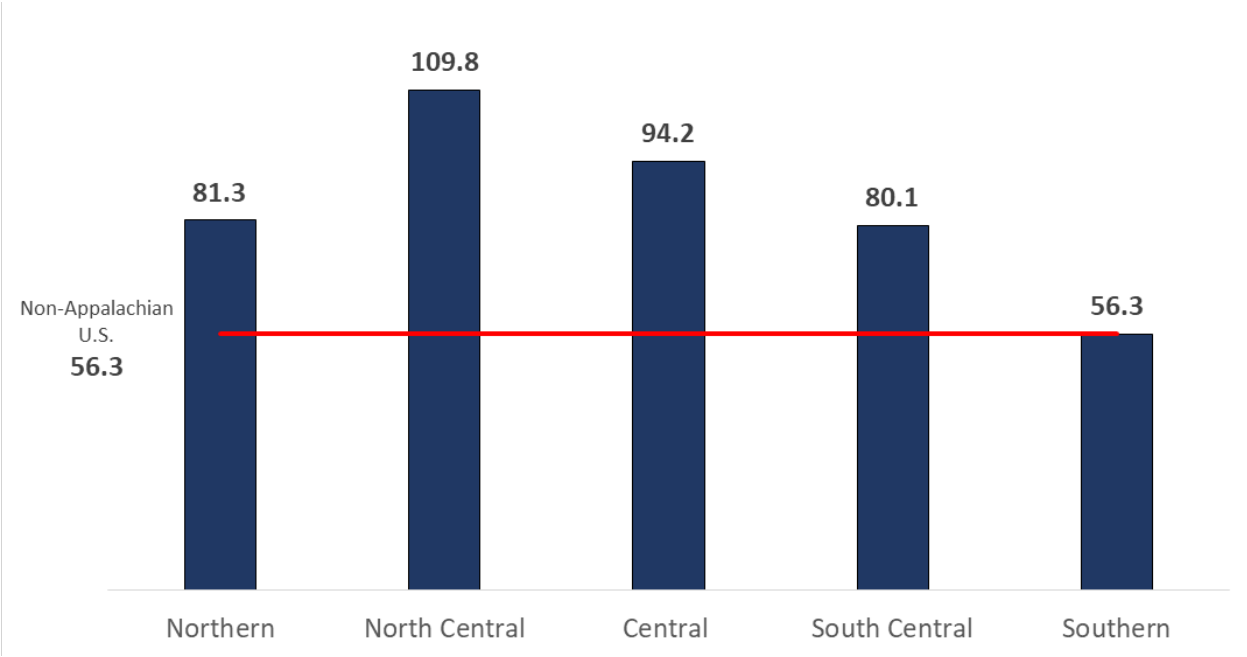
## Exhibit 15. Diseases of despair mortality rates, ages 15–64, by state^ and disease (2018)‡




^ For states within Appalachia, only the mortality rate for the Appalachian counties is shown.
‡ Rates are presented as deaths per 100,000 population. Rates are age adjusted.
Source: Mortality Rates and Standard Errors provided by Centers for Disease Control and Prevention, National Center for Health Statistics.
Accessed at http://wonder.cdc.gov/mcd-icd10.html.

In 2018, the highest burden of diseases of despair within Appalachia was concentrated in North Central Appalachia and Central Appalachia. Exhibit 16 shows the mortality rates for Appalachian subregions. North Central and Central Appalachia had a mortality rate from diseases of despair of 109.8 deaths per 100,000 population and 94.2 deaths per 100,000 population, respectively. Southern Appalachia had the lowest mortality rate from diseases of despair at 56.3 deaths per 100,000 population, which was equal to the non-Appalachian U.S. diseases of despair mortality rate in 2018.

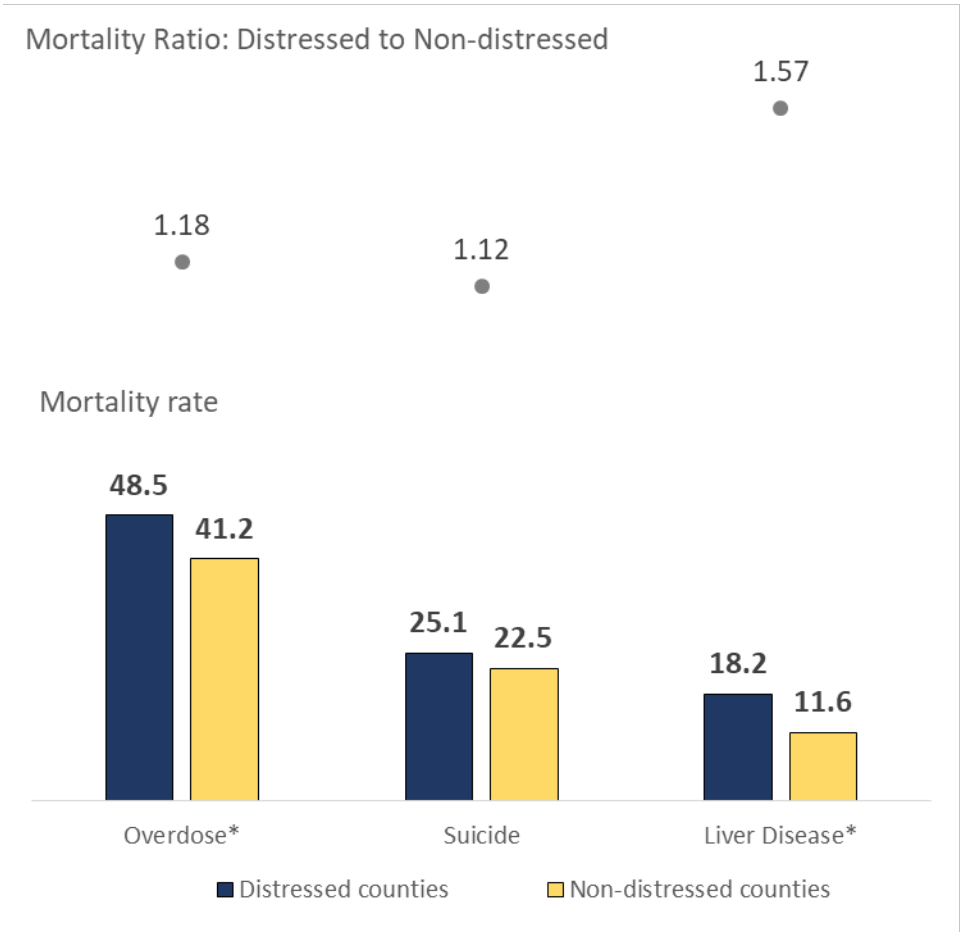
**Exhibit 16.** Diseases of despair mortality rates, ages 15–64, by subregion (2018)‡




‡ Rates are presented as deaths per 100,000 population. Rates are age adjusted.
Source: Mortality Rates and Standard Errors provided by Centers for Disease Control and Prevention, National Center for Health Statistics.
Accessed at http://wonder.cdc.gov/mcd-icd10.html.

Exhibit 17 shows the mortality rate for each individual disease of despair, comparing distressed and non-distressed counties. While overdose deaths were the most common among the three diseases of despair, the disparity between distressed and non-distressed counties was greatest for alcoholic liver disease/cirrhosis (57 percent higher in distressed counties). The mortality rate for overdose and suicide was 18 percent and 12 percent higher in distressed counties than non-distressed counties, respectively. The difference between distressed and non-distressed counties was statistically significant for overdose and liver disease.

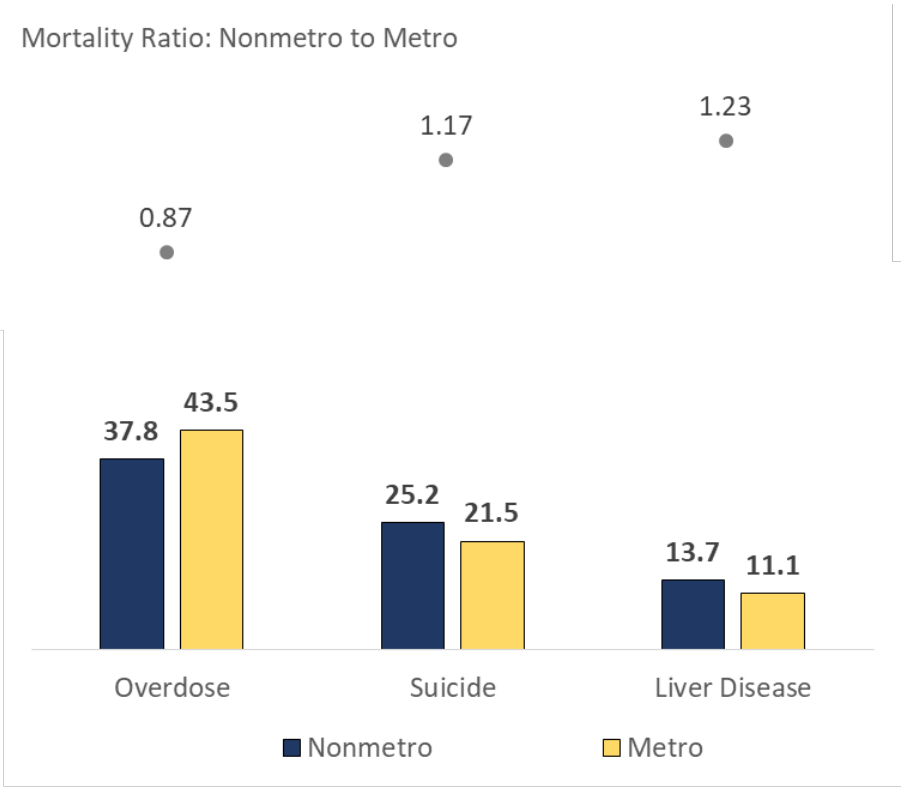
**Exhibit 17**. Diseases of despair mortality rates, ages 15–64, by disease and county economic status (2018)‡




‡ Rates are presented as deaths per 100,000 population. Rates are age adjusted.
* Rate for distressed counties is significantly different from rate for non-distressed counties, $p \leq 0.05$.
Source: Mortality Rates and Standard Errors provided by Centers for Disease Control and Prevention, National Center for Health Statistics.
Accessed at http://wonder.cdc.gov/mcd-icd10.html.

Findings varied based on rurality, as shown in Exhibit 18. In nonmetro counties, the suicide rate was 17 percent higher than in metro counties, and the alcoholic liver disease/cirrhosis mortality rate was 23 percent higher. The overdose rate in nonmetro counties was 13 percent lower than in metro counties. The differences between metro and nonmetro counties were statistically significant for overdose, suicide, and liver disease.

**Exhibit 18**. Diseases of despair mortality rates, ages 15–64, by disease and rurality (2018)‡*

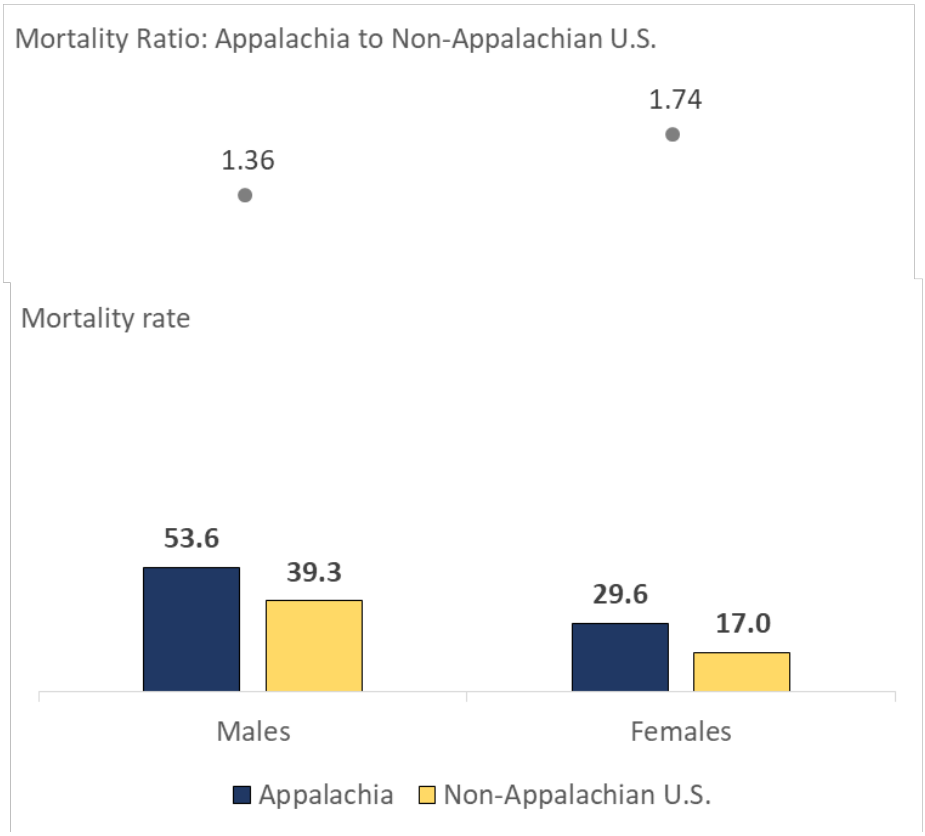



‡ Rates are presented as deaths per 100,000 population. Rates are age adjusted.
* For all diseases, rate for nonmetro counties is significantly different from the rate for metro counties, $p \leq 0.05$.
Source: Mortality Rates and Standard Errors provided by Centers for Disease Control and Prevention, National Center for Health Statistics.
Accessed at http://wonder.cdc.gov/mcd-icd10.html.

## A Closer Look at Overdose Deaths

The remaining findings focus solely on deaths due to alcohol, prescription drug, and illegal drug overdose (overdose deaths). Among individuals ages 25–54, traditionally considered the working-age population, the overdose mortality rate was 55 percent higher in the Appalachian Region (53.2 deaths per 100,000 population), compared to 34.3 deaths per 100,000 in the non-Appalachian U.S. Exhibit 19 shows the differences in overdose mortality between the Appalachian Region and non-Appalachian U.S. for males and females. While the burden associated with overdose mortality is higher among males (53.6 deaths per 100,000 in Appalachia compared to 39.3 deaths per 100,000 in the non-Appalachian U.S.), the disparity is greater for females in the Appalachian Region. Specifically, the overdose mortality rate in the Appalachian Region among females is 74 percent higher than the overdose mortality rate in the non-Appalachian U.S.

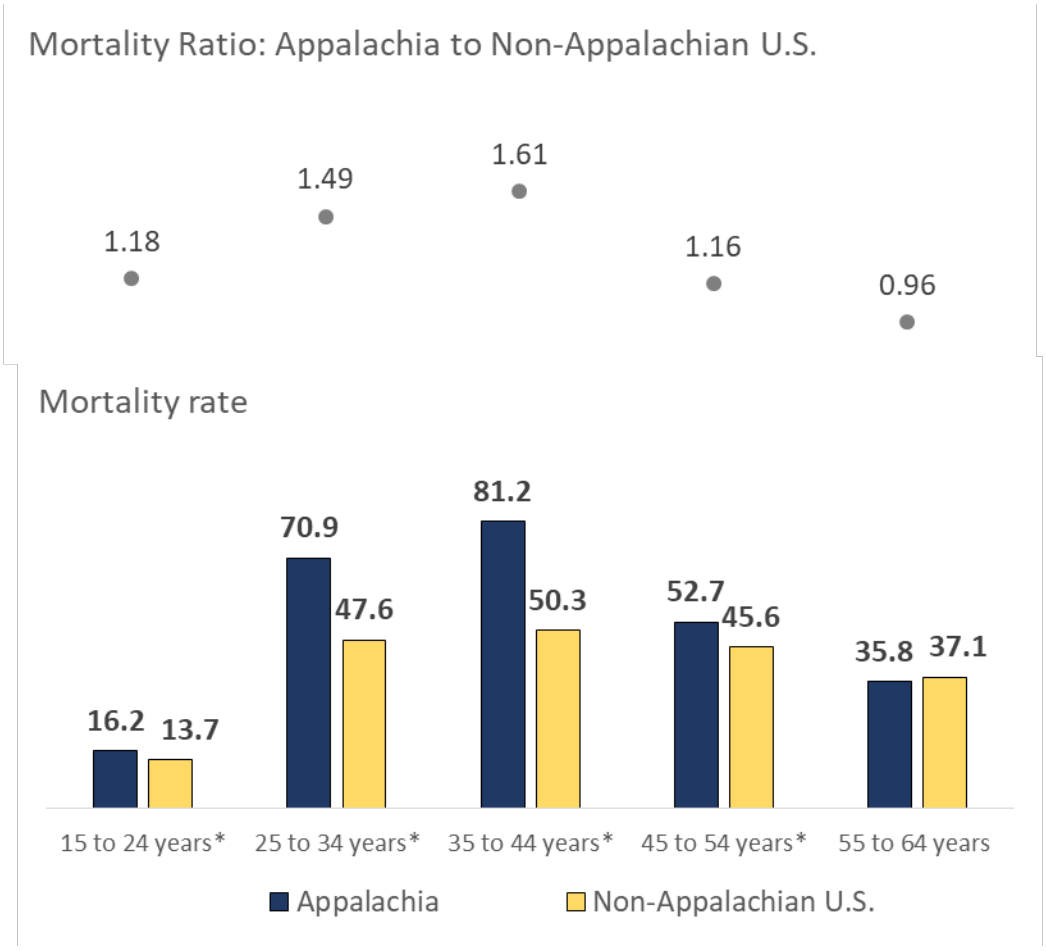
**Exhibit 19.** Overdose mortality rates, ages 15–64, by gender and region (2018)‡*




‡ Rates are presented as deaths per 100,000 population. Rates are age adjusted.
* For both genders, Appalachian rate is significantly different from the non-Appalachian U.S. rate, $p \leq 0.05$.
Source: Mortality Rates and Standard Errors provided by Centers for Disease Control and Prevention, National Center for Health Statistics.
Accessed at http://wonder.cdc.gov/mcd-icd10.html.

Males in Appalachia ages 25–44 experienced notable disparities compared to non-Appalachian males, as shown in Exhibit 20. In Appalachia, the overdose mortality rate was 61 percent higher among men ages 35–44 and 49 percent higher among men ages 25–34 compared to non-Appalachian males. The burden in the region was also highest for these two age groups, at 81.2 deaths per 100,000 population and 70.9 deaths per 100,000, respectively. For working-age males 25–54, the overdose mortality rate in the Appalachian Region (69.1 deaths per 100,000 population) was 44 percent higher than the overdose mortality rate for males in the non-Appalachian U.S. (48.0 deaths per 100,000 population). For all male age groups except 55–64, the overdose mortality rate in the Appalachian Region was higher than the non-Appalachian U.S. rate, and the difference was statistically significant.

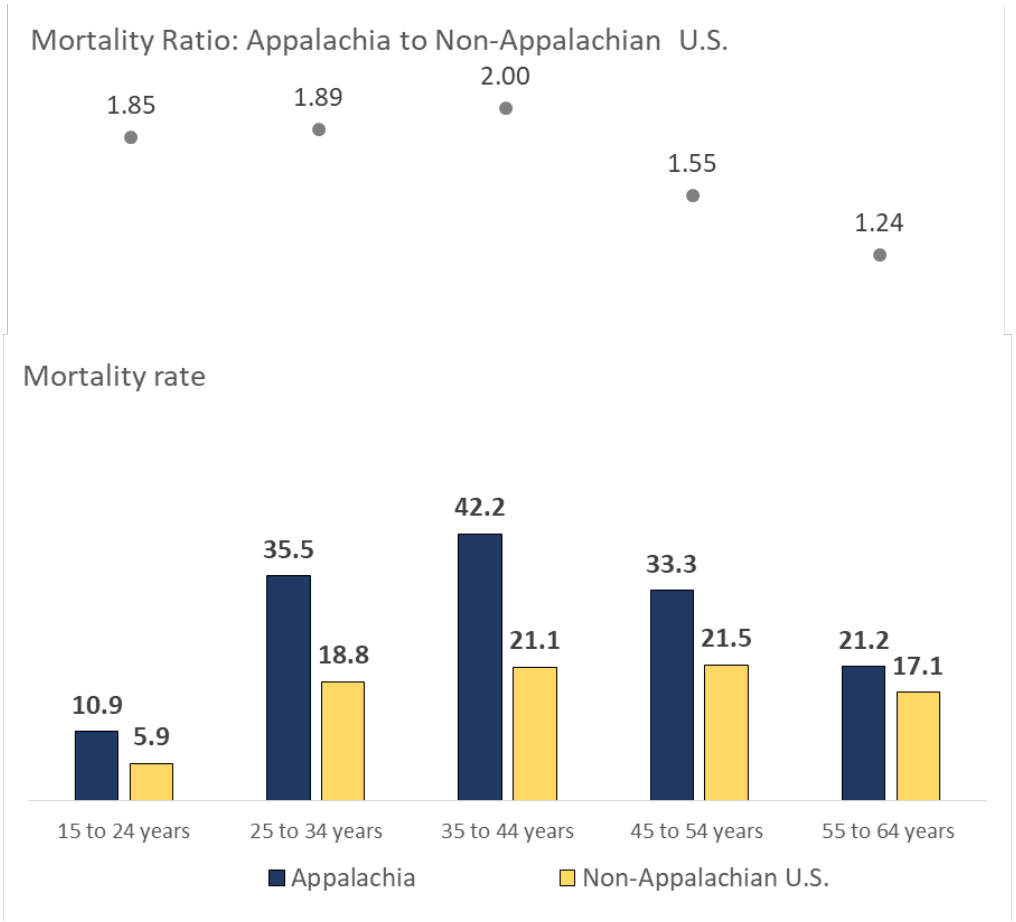
**Exhibit 20.** Overdose mortality rates for males, ages 15–64, by age group and region (2018)‡




‡ Rates are presented as deaths per 100,000 population. Rates are crude mortality rates for each age group.
* Appalachian rate is significantly different from the non-Appalachian U.S. rate, $p \leq 0.05$.
Source: Mortality Rates and Standard Errors provided by Centers for Disease Control and Prevention, National Center for Health Statistics.
Accessed at http://wonder.cdc.gov/mcd-icd10.html.

While the overall overdose mortality burden was lower among females than males, the disparity between Appalachia and the non-Appalachian U.S. was even larger than the disparity among males, as shown in Exhibit 21. Females ages 35–44 were most impacted: The overdose mortality rate for Appalachian females in that age group was double that of females in the non-Appalachian U.S., and among 25- to 34-year-olds, the Appalachian rate was 89 percent higher. Among females, the highest overdose mortality rate was among 35- to 44-year-olds, at 42.2 deaths per 100,000 population. The overdose mortality rate for working-age females, ages 25–54, was 82 percent higher in the Appalachian Region (37.3 deaths per 100,000 population) than in the non-Appalachian U.S. (20.5 deaths per 100,000 population). For all female age groups, the overdose mortality rate in the Appalachian Region was higher than the non-Appalachian U.S. rate, and the difference was statistically significant.

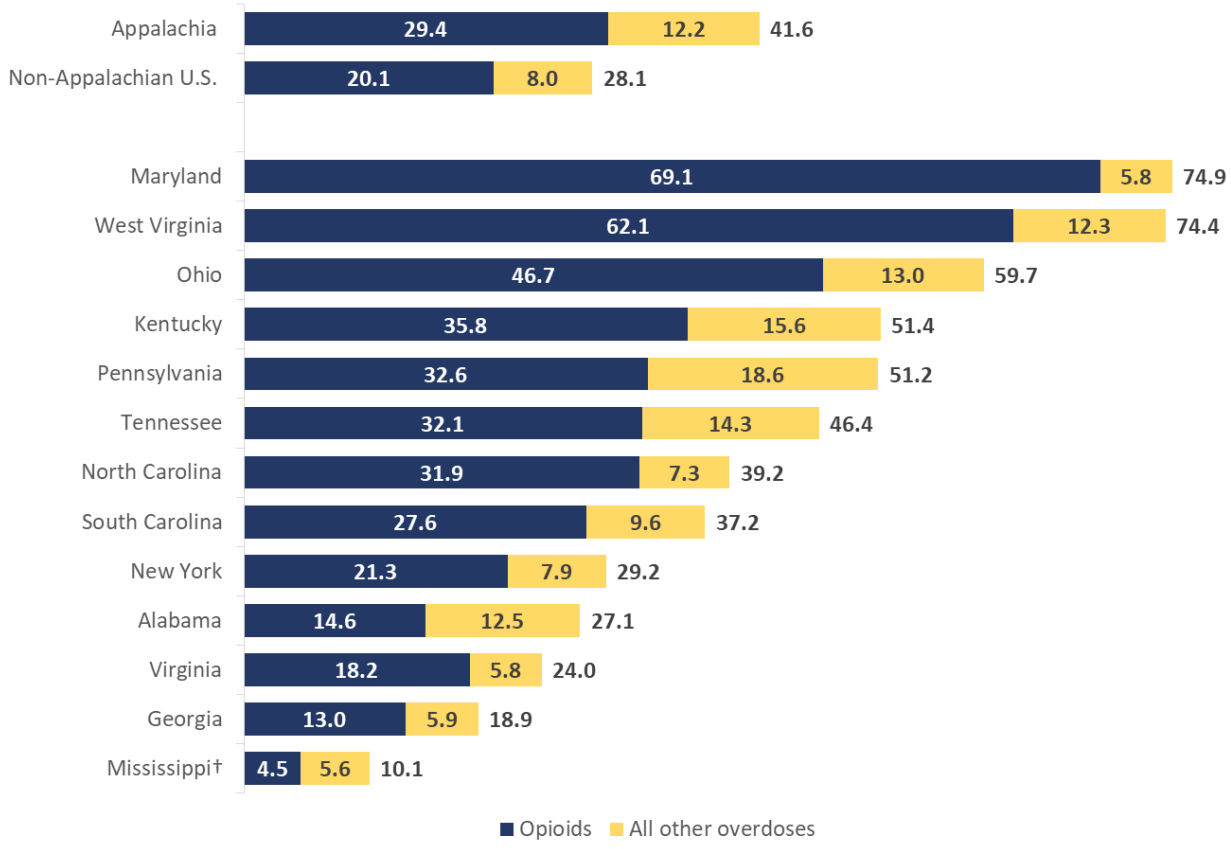
**Exhibit 21.** Overdose mortality rates for females, ages 15–64, by age group and region (2018)‡*




‡Rates are presented as deaths per 100,000 population. Rates are crude mortality rates for each age group.
* For all age groups, Appalachian rate is significantly different from the non-Appalachian U.S. rate, $p \leq 0.05$.
Source: Mortality Rates and Standard Errors provided by Centers for Disease Control and Prevention, National Center for Health Statistics.
Accessed at http://wonder.cdc.gov/mcd-icd10.html.

Exhibit 22 shows the total overdose mortality rates in addition to the opioid-related overdose rates in the Appalachian portions of each state. In the Appalachian Region in 2018, 4,548 of the 6,483 overdose deaths (70 percent) were caused by opioids. The states with the highest opioid-related overdose mortality rates within their Appalachian counties were Maryland (69.1 deaths per 100,000 population); West Virginia (62.1 deaths per 100,000 population); and Ohio (46.7 deaths per 100,000 population). The states with the highest percentages of overdose deaths attributed to opioids within their Appalachian portions were Maryland (92 percent); West Virginia (83 percent); North Carolina (81 percent); Ohio (78 percent); and Virginia (76 percent). The opioid-related overdose mortality rate was lowest in Appalachian Mississippi (4.5 deaths per 100,000 population); Appalachian Georgia (13.0 deaths per 100,000 population); and Appalachian Alabama (14.6 deaths per 100,000 population).

**Exhibit 22.** Overdose mortality rates, ages 15–64, by state^ and type of overdose (2018)‡




^ For states within Appalachia, only the mortality rates for the Appalachian counties are shown.
‡ Rates are presented as deaths per 100,000 population. Rates are age adjusted.
† Due to small number of deaths, opioid mortality rate is unreliable and not age adjusted.
Source: Mortality Rates and Standard Errors provided by Centers for Disease Control and Prevention, National Center for Health Statistics.
Accessed at http://wonder.cdc.gov/mcd-icd10.html.

Exhibit 23 shows the percentages of overdose deaths attributed to opioids in each state, in addition to the opioid-related overdose mortality rate. The opioid-related mortality rate was 29.4 deaths per 100,000 in the Appalachian Region, which was 46 percent higher than the non-Appalachian U.S. rate of 20.1 deaths per 100,000.

**Exhibit 23.** Overdose and opioid-related overdose mortality rates, ages 15–64, by state^ (2018)‡

| | Overdose | Opioid-related Overdose | Opioid-related (%) |
|---|---|---|---|
| **Alabama** | 27.1 | 14.6* | 54% |
| **Georgia** | 18.9* | 13.0* | 69% |
| **Kentucky** | 51.4* | 35.8* | 70% |
| **Maryland** | 74.9* | 69.1* | 92% |
| **Mississippi†** | 10.1* | 4.5* | 45% |
| **New York** | 29.2 | 21.3 | 73% |
| **North Carolina** | 39.2* | 31.9* | 81% |
| **Ohio** | 59.7* | 46.7* | 78% |
| **Pennsylvania** | 51.2* | 32.6* | 64% |
| **South Carolina** | 37.2* | 27.6* | 74% |
| **Tennessee** | 46.4* | 32.1* | 69% |
| **Virginia** | 24.0 | 18.2 | 76% |
| **West Virginia** | 74.4* | 62.1* | 83% |
| **Appalachia** | 41.6* | 29.4* | 71% |
| **Non-Appalachian U.S.** | 28.1 | 20.1 | 72% |

^ For states within Appalachia, only the mortality rate for the Appalachian counties is shown.
‡ Rates are presented as deaths per 100,000 population. Rates are age adjusted.
* Rate is significantly different than the non-Appalachian U.S. rate, $p \leq 0.05$.
† Due to small number of deaths, opioid mortality rate is unreliable and not age adjusted.
Source: Mortality Rates and Standard Errors provided by Centers for Disease Control and Prevention, National Center for Health Statistics.
Accessed at http://wonder.cdc.gov/mcd-icd10.html.

# Discussion

This report provides an update to the 2015 Appalachian diseases of despair study. For both the Appalachian Region and the non-Appalachian United States, diseases of despair mortality rates continued to increase between 2015 and 2017, before declining in 2018. Between 2015 and 2018, the overall disparity between Appalachia and the rest of the nation for diseases of despair remained stable; however, the disparities shifted for the individual diseases of despair. Specifically, while a significant disparity between Appalachia and the non-Appalachian U.S. for overdose mortality continued through 2018, the gap narrowed. In 2015, the overdose mortality rate was 65 percent higher in Appalachia than the non-Appalachian U.S., and in 2018, the Appalachian overdose mortality rate was 48 percent higher than the non-Appalachian U.S. While the disparity was declining for overdose mortality, the gap widened for both suicide and liver disease/cirrhosis mortality.

In 2018, the Appalachian Region saw its first decline in diseases of despair mortality and overall mortality rate since 2011–2012, which was likely influenced by declines in drug overdose mortality within the Region in 2018. While the overdose mortality rate declined between 2017 and 2018, the suicide and liver disease/cirrhosis mortality rates continued to increase.

Compared to the rest of the nation, the Appalachian Region experienced higher rates of mortality from diseases of despair for all 10-year age ranges between 15 and 64. The most notable disparities existed for the 35–44 group. More specifically, that group experienced mortality rates 60 percent higher than the non-Appalachian U.S. These findings have significant implications, particularly in terms of economic development, as individuals in their prime working years are most impacted.

Within Appalachia, the burden of diseases of despair mortality shifted for different subregions between 2015 and 2018. In 2015, Central Appalachia had the highest diseases of despair mortality rate, followed by North Central Appalachia. The North Central Appalachia diseases of despair mortality rate increased significantly between 2015 and 2018, from 88.6 deaths per 100,000 to 109.8 deaths per 100,000 population. In contrast, the Central Appalachian diseases of despair mortality rate remained fairly constant between 2015 and 2018, from 94.4 deaths per 100,000 in 2015 to 94.2 deaths per 100,000 in 2018. Additionally, economically distressed counties had higher mortality rates for overdose, suicide, and liver disease/cirrhosis. While the overdose mortality rates increased for both distressed and non-distressed counties between 2015 and 2018, the disparity between distressed and non-distressed counties declined, from 34 percent to 18 percent higher in the distressed counties. In 2018, the overdose mortality rate in distressed counties was 48.5 deaths per 100,000 compared to 41.2 deaths per 100,000 in non-distressed counties. For liver disease/cirrhosis, the mortality rate for distressed counties was 57 percent

higher (18.2 deaths per 100,000) than non-distressed counties (11.6 deaths per 100,000). In comparison, in 2015 the liver disease mortality rate was 38 percent higher in distressed counties (15.4 deaths per 100,000) than non-distressed counties (11.2 deaths per 100,000).

Findings varied by rurality based on the specific disease of despair. While the rate of overdose deaths was greater in metro counties in Appalachia, the rates of suicide and alcoholic liver disease/cirrhosis were higher in nonmetro counties. More detailed analyses of opioid-related overdose deaths showed that in 2018, opioids caused 70 percent, or 4,548 deaths, in Appalachia. The Appalachian counties of states within the Region varied dramatically in terms of their overall overdose mortality, and the percentage attributable to opioids.

Diseases of despair mortality rates—and particularly overdose mortality rates—increased dramatically between 2015 and 2017. While overdose rates began to decline in 2018, provisional data from CDC has shown rising numbers of drug overdose deaths in 2019.[14] Additionally, anecdotal evidence has suggested dramatic increases in overdose deaths in many regions during the COVID-19 pandemic. The impact of COVID-19 will likely lead to an increase in mortality from diseases of despair, particularly as the Appalachian Region and the rest of the United States experience economic challenges as a result of the pandemic, isolation, and limitations on access to in-person treatment and recovery support. It will be important to continue to monitor these trends in diseases of despair mortality in the Appalachian Region.

# Appendix A: ICD-10 Codes

## Exhibit 24. Underlying cause of death—ICD-10 codes for diseases of despair

| Diseases of Despair | ICD-10 Code | Underlying Cause of Death |
|---|---|---|
| **Alcoholic poisoning and overdoses of prescription and illegal drugs (Overdose)** | X40-45 | Accidental poisoning by and exposure to: nonopioid analgesics, antipyretics, and antirheumatics; antiepileptic, sedative-hypnotic, antiparkinsonism, and psychotropic drugs; narcotics and psychodysleptics [hallucinogens]; other drugs acting on the autonomic nervous system; other and unspecified drugs, medicaments, and biological substances; and alcohol |
| | Y10-15 | Poisoning by and exposure to the following (undetermined intent): nonopioid analgesics, antipyretics and antirheumatics, undetermined intent; antiepileptic, sedative-hypnotic, antiparkinsonism and psychotropic drugs; narcotics and psychodysleptics [hallucinogens]; other drugs acting on the autonomic nervous system; other and unspecified drugs, medicaments and biological substances, alcohol) |
| | Y45 | Analgesics, antipyretics and anti-inflammatory drugs |
| | Y47 | Sedatives, hypnotics and antianxiety drugs |
| | Y49 | Psychotropic drugs, not elsewhere classified |
| **Suicide** | X60-84 | Intentional self-harm |
| | Y87.0 | Sequelae of intentional self-harm |
| **Alcoholic liver disease/cirrhosis** | K70 | Alcoholic liver disease |
| | K73 | Chronic hepatitis, not elsewhere classified |
| | K74 | Fibrosis and cirrhosis of liver |

## Exhibit 25. Multiple causes of death—ICD-10 codes for opioid-related overdose

| Disease of Despair | ICD-10 Code | Multiple Causes of Death |
|---|---|---|
| **Alcoholic poisoning and overdoses of prescription and illegal drugs (Overdose)** | T40.0 | Opium |
| | T40.1 | Heroin |
| | T40.2 | Other opioids |
| | T40.3 | Methadone |
| | T40.4 | Other synthetic narcotics |
| | T40.6 | Other and unspecified narcotics |

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