Drew University
College of Liberal Arts

The Opioid Crisis in the United States:
An Exploratory Data Analysis of the Driving Factors

A Thesis in International Relations

by

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Abstract

In this thesis, I study the opioid crisis in the United States between the years of 1999 and 2017 using an exploratory data analysis with an emphasis on data visualization. I use a multi-level geographic approach, starting at the international level by comparing opioid consumption in North America to other regions of the world using data from the United Nations and its associated agencies. From there, I move onto consumption patterns at the state level using data from the CDC, which includes disaggregations by sex. At the county level, I focus on opioid use in the Appalachian Region (the area of the country that was most impacted by the crisis) and the specific counties and subregions with the highest overdose rates.

I breakdown the crisis into several potential driving factors using data from multiple sources in order to understand the socioeconomic and geographic conditions of the Appalachian Region that laid the foundation for the epidemic in the region. By exploring the relationship between each variable and opioid use, I am able to contribute to the explanation of why certain areas of the country were more vulnerable to opioid abuse than others. Finally, I include a discussion of the steps that have been taken by the federal government and its agencies to address the epidemic. I then make recommendations for how to combat the opioid crisis based on my findings from this thesis.

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Introduction

The opioid crisis is a global problem that has taken the lives of millions of people around the world, including just over 700,000 Americans alone (CDC 2020). There are several factors that have laid the foundation for the epidemic to have such damaging international effects, but the consequences in the United States itself are the point of focus for this thesis. Behind America's opioid crisis, the driving forces are found in the deleterious actions of pharmaceutical companies, the overprescribing of opioids by doctors (which is related to the pain management culture in the country) and finally the numerous structural challenges that are especially prominent in rural America. At the forefront of this are economic distress, educational attainment, and rurality which includes limited access to healthcare and treatment in the form of primary care physicians, mental health providers, and opioid treatment facilities. I will analyze these indicators extensively at the county level for the Appalachian Region in order to study their relationship with opioid use by this rural population.

This thesis is an exploratory data analysis of the opioid crisis as my main goal is to examine how the different variables I am investigating might account for why certain parts of the country were more vulnerable to the epidemic than others.

I divided the thesis into six sections. In section one, I explain how the opioid crisis has been addressed at the international level and then I compare the opioid consumption patterns of different regions of the world using data from the United Nations. Since this investigation relies on data science and data visualizations as the primary methods, I explain the significance of visualizing information and its best

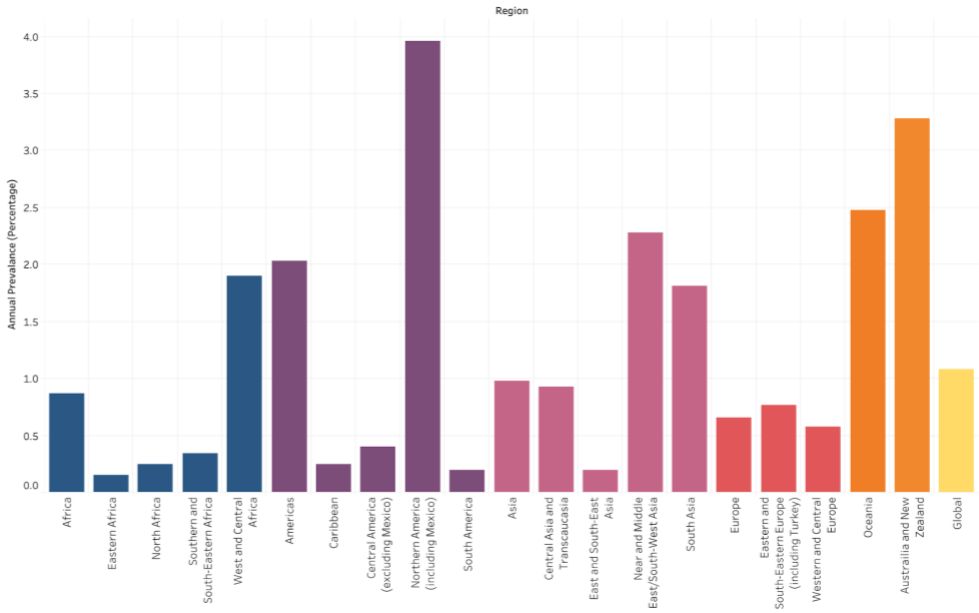
practices. Section three outlines each variable that I study and its associated source, while section four is where I dive into the indicators and explore their relationships with opioid use. I focus on state level opioid overdose data over a 15-year period and then move on to the Appalachian Region, which is where I dive deeper into each variable. I discuss government policy regarding the opioid crisis in section five and I make recommendations on how to combat the crisis, focusing on data collection efforts and alternative pain management techniques. Finally, I conclude with section six which reiterates the importance of using data visualizations to thoroughly investigate the opioid crisis in the manner that I did.

I. Opioid Consumption Patterns Around the World

I will examine the crisis at several geographic levels to provide macro and micro approaches. In order to first explain how the epidemic has impacted the rest of the world in comparison to the United States, I will provide the part of the United Nations' agenda that relates to the epidemic. This will also allow us to understand the international community's efforts to address the crisis. The United Nations released the Sustainable Development Goals (SDGs) in 2015. They were an updated version of its Millennium Development Goals, which were conceived to hold all countries accountable to the global improvement indicators. Since member nations have varying levels of development, they are expected to focus on achieving the goals that are within their reach and integrate them into their policies.

Each goal has several specific targets that serve as subcategories to provide guidance for countries in their efforts to combat poverty, promote prosperity for all

people and protect the planet. Goal 3 calls to “ensure healthy lives and promote well-being for all at all ages” and the fifth target is to “strengthen the prevention and treatment of substance abuse, including narcotic drug abuse and harmful use of alcohol” (UN DESA 2018). The United Nations recognizes drug use as a global problem that requires the attention of all nations. This is not only evident by the framework of the SDGs, but also by the fact that the UN established an entirely separate agency dedicated to drug prevention in 1997. The UN Office on Drugs and Crime (UNODC) uses the SDGs to guide member nations towards solutions which are too substantial for them to combat on their own. One of its annual publications is the *World Drug Report* which includes detailed research of trends, policies and statistical analyses of the current drug problems that the world is facing (UNODC 2019). These reports provide an international perspective of the most pressing drug epidemics not only within nations, but also ones that transcend countries. The focus on opioids in the recent *World Drug Reports* is an example of both of these types, whereby the usage is a problem affecting many countries, not just the United States. The difference is the magnitude at which Americans are abusing opioids despite how developed this country is. Below is a graph showing the distribution of the annual prevalence of non-medical opioid use by region in 2017 as a percentage of the total population.



North America leads the way with an estimated 4% of the 15-64 aged population while Australia and New Zealand are not far behind with 3.3%. The global prevalence of 1.1% puts these numbers into perspective, emphasizing the fact that North America comprises one-quarter of global opioid users (World Drug Report 2019). The 2019 World Drug Report cites Fischer, Keates, Bühringer, Reimer, and Rehm's research on prescription opioid use in North America compared to the rest of the world, specifically other high-income countries (HICs). The report highlights several contributing factors, "including the organization of the health system's structures for regulation and control of access to those drugs, prescription practices, the medical dispensing culture and patient expectations" (UNODC 2019). These studies focus on the United States and Canada, but this thesis will analyze opioid use within the United States alone to address these factors on a more micro scale.

II. Data Visualization

Explaining complex subjects such as the causes and contributing factors of the opioid crisis can be especially difficult, but the inclusion of data visualizations will aid in understanding the findings. The goal of these visualizations is not to "replace narrative", but to be used in combination with it to improve understanding and to "elucidate patterns, gaps, schemes, regularities, and connections that may not be easily identified by rapidly reading raw data or long texts" (Gatto 2015, 5). I will use them primarily throughout this thesis in order to support the ideas that are presented in a way that can be translated across many disciplines as data visualizations "improve the understanding of data for experienced researchers, statisticians, and academics, as well as for a much broader non-specialist audience" (5). In Malu Gatto's paper, he includes guidelines for best practice of using data visualizations in academic settings and provides warnings regarding the wide dissemination of data in visual forms due to their potentially deceptive qualities. Data visualizations are the epitome of the saying: "a picture is worth a thousand words," but it is important to understand that a picture can be interpreted in many ways, some of which can be incorrect. On a similar note, it is crucial not to oversimplify the data to the point where it masks the complexity of the variables. Acknowledging these points, the visualizations included throughout this thesis are by no means complicated or deceiving to influence a certain takeaway, they are simply supplementing the written narratives which describe the trajectory of the opioid crisis. I will fully explain the data that is being visualized and in the case of two visuals being compared, I will address the different legends in order to ensure that the information is clear.

I will be displaying the data using graphs and maps as this is the most effective route for the amount of geographic data that is analyzed. It is also the best way to detect patterns not only at the various geographic levels, but also between the numerous indicators. Each measure will be displayed side-by-side to the county level opioid overdose map to make the visual detection of patterns easier. I also provide the data sources in a chart format to clearly indicate where each variable is coming from. This is an integral part of the development of the data community, allowing for readers to conduct their own research, create their own visualizations and conclude their own findings. I cleaned the data in Microsoft Excel, specifically using Lookup formulas, and then visualized in Tableau, mapping by FIPS codes[1]. Tableau is a data visualization software that allows for more manipulation than the rudimentary charts and graphs. A description and analysis will accompany each visualization to guide the reader through the findings of this thesis.

Remo Aslak Burkhard and Michael Meier (2005) argue the uses for visualization techniques and the ways in which they can be used to overcome the challenges of relaying detailed information to an audience of various academic disciplines. Regarding maps in particular, the authors suggest that they "help to present the overview and the details, to structure information, to motivate and activate employees, to establish a common story, and to ease access to information" (Burkhard and Meier 2005, 10). In this case, data visualizations sparked my continued interest in this epidemic and they were

[1] FIPS (or Federal Information Processing Standards) Codes are unique numerical identifiers for various geographic levels. At the county level, they are five-digit codes given to each county (or county equivalent) in the country. The first two digits are the FIPS code for the state in which the county is located.

used throughout the entire process from start to finish. I initially told the story of the crisis at the summary level strictly using visualizations which helped me to decide which indicators I wished to explore at deeper geographic levels.

III. Data and Methods

Based on the literature review discussed below, I will provide the variables that are being explored in this thesis and their corresponding data sources. First, I include the geographic levels that are used for each indicator in addition to the Appalachian Region county classification system based on rurality. The multi-level approach in terms of international, state, and county analyses provides a comprehensive view of the opioid crisis. The global comparison, which included data from the UNODC Drug Report, serves as an overview to show the position of the United States on the global stage. The state level, which includes data predominantly gathered from the CDC, provides the ability to determine the regions that have historically suffered the most and the ones that can be studied more in-depth. Finally, the county level, including data from various sources, is the most important for discovering trends in the data and understanding how the variables behave in specific areas. The benefit of using state level data is that it is more readily available over a longer period of time, but both the state and international levels leave too much room for variation in the data, making it difficult to analyze specific trends. The county approach provides the most accurate analysis and contributes to the ability to find solutions to the epidemic.

Below is a chart that outlines the variables and the associated sources organized by data groups for simplicity purposes.

Data Group	Indicator	Source
Opioids	◦ Annual Prevalence of Non-Medical Opioid Use by Region (International) ◦ Opioid Overdose Death Rate (State/county)	◦ UNODC ◦ CDC WONDER
Geographic	◦ Urban-Rural Classification Scheme ◦ Urban-Rural Delineation	◦ National Center for Health Statistics ◦ Census Bureau
Socioeconomic	◦ Life Expectancy ◦ County Economic Status ◦ Unemployment Rates ◦ Composition of Employment Sector ◦ Educational Attainment ◦ Access to Healthcare	◦ World Development Indicators (WB) ◦ Appalachian Regional Commission ◦ Bureau of Labor Statistics ◦ Appalachian Regional Commission ◦ Census' American Community Survey ◦ County Health Rankings and Roadmaps

The following is a more thorough explanation of each indicator in order of their appearance in this thesis. The life expectancy rates at birth for the United States are compared to OECD member countries to control for development using data from the World Bank's World Development Indicators database between 1960 and 2017. The data for the US are then disaggregated by race in addition to sex using the CDC's National Vital Statistics Reports data tables.

To calculate the proportion of the population that has died as a result of an opioid overdose, I used data from the CDC's Multiple Cause of Death Data Request center. I downloaded these rates at the state and county levels for populations ages 15-64 as this group most accurately represents the working-age population for whom economic conditions would have the most significant impact. I initially chose the years 1999 to 2017 in order to provide a complete picture of the crisis and account for economic, structural, and environmental changes in a region as well as the three waves of the crisis.

However, the years prior to 2002 did not provide meaningful data due to inaccurate and underdeveloped methods of data collection, therefore I used 2002 to 2017 throughout the indicators. I include studies (Monnat and Rigg 2018; Dean and Kimmel 2019) that investigated aspects of the crisis from 1999 onwards, specifically the change in overdose death rates for men and women and the effects that trade-related job loss had on opioid abuse. I downloaded the data in five-year increment groups in order to increase reportability. The Underlying Causes of Death were: "Drug Poisonings- Unintentional", "Suicide", "Homicide", and "Undetermined". The Multiple Causes of Death codes were: "Poisoning by Narcotics and Psychodysleptics"- "Opium", "Heroin", "Other opioids", "Methadone", "Other Synthetic Narcotics", and "Other and Unspecified Narcotics."[2]

I completed breakdowns of the data by sex and race and ethnicity at the state level to provide an overview analysis of how overdose rates have historically varied for males and females and for non-Hispanic whites, non-Hispanic black or African Americans, and Hispanic or Latinos. While stratifying the data by sex and race and ethnicity made the sample sizes too small for some states during certain years or did not provide meaningful values, I was still able to make sense of the crisis by explaining the relationship between these three variables.

I encountered several obstacles in my ability to produce numerical values at the county level due to suppressed and unreliable values which are to ensure confidentiality

[2] The codes for the Underlying Causes of Death are: "Drug Poisonings- Unintentional (X40-X44)", "Suicide (X60-X64)", "Homicide (X85)", and "Undetermined (Y10-Y14)".
The Multiple Causes of Death codes are: "Poisoning by Narcotics and Psychodysleptics"- "Opium (T40.0)", "Heroin (T40.1)", "Other opioids (T40.2)", "Methadone (T40.3)", "Other Synthetic Narcotics (T40.4)", and "Other and Unspecified Narcotics (T40.6).

and accuracy, respectively. When the death count is fewer than 10 people, the age-adjusted rate is suppressed to avoid the potential of identifying confidential patient information. When the death count is fewer than 20 people, the age-adjusted rate is listed as ‘unreliable’ because of the inability to distinguish between random chance and actual variation. To address the limited numerical reporting issue, I followed the NORC model and I downloaded county level data for the years 2013-2017 by state for all races and ethnicities and sexes. For rates that were reported as unreliable, the crude death rate was calculated using the total population as opposed to the age-adjusted rates (which use the 2000 US standard population that were provided by the CDC). The population that the CDC provided is the combined value over the five-year period for ages 15-64, which was used as the denominator to calculate crude rates. The number of deaths served as the numerator and the result was displayed as a rate per 100,000 people.

To address the rural-urban divide that exists at the county level in the Appalachian Region, two different methods will be used for classification. First is the 2013 National Center for Health Statistics (NCHS) Urban-Rural Classification Scheme, whereby urban versus rural counties will be further divided into subcategories to provide a clear explanation of how geographic characteristics have affected opioid use over the past two decades in the Appalachian Region. Urban, or metropolitan counties will be divided between large and medium/small counties: the former existing in metropolitan statistical areas of 1 million people or more and the latter in areas less than 1 million. Large counties include both Large Central Metro, or inner cities, and Large Fringe Metro counties, or suburbs. Rural, or nonmetropolitan counties are divided into two parts:

Micropolitan and Noncore. Micropolitan Nonmetro counties are in micropolitan statistical areas with populations between 10,000 and 50,000 people, while Noncore Nonmetro counties are those that are not in a cluster and have populations of less than 10,000 people.

The Census Bureau uses an urban-rural classifications system that is more straightforward but does not account for the differences that exist within urban and rural communities. In the above rurality system, urban areas are divided between inner cities and suburbs and rural counties are divided between those in a micropolitan statistical area and those that are not. This serves as a useful tool when analyzing socioeconomic and demographic indicators because it allows for a more accurate depiction of rural-urban welfare disparities. However, the Census' method is based on population which is the more common manner of addressing rural-urban differences. The inclusion of both classification methods can determine the more appropriate scheme for this discussion. The Census divides counties into three groups: mostly urban, mostly rural and completely rural. Counties that have less than half of their population living in rural areas are considered mostly urban, 50 to 99.9% in rural areas are mostly rural and 100% of the population in rural areas are completely rural.

In terms of economic prosperity in the Appalachian Region, several indicators will be utilized to provide a complete picture of the financial environment. This will also allow for a further exploration of the composition of Appalachian counties and the relationship between rurality and prosperity. The Appalachian Regional Commission (ARC) classifies each county by economic status based on the performance of three

indicators: the unemployment rate, per capita income, and the poverty rate. The Commission compares the county's averages for each indicator to the national averages as a percentage. These three values are then averaged to create a composite index value for each county in the country which produces a ranking system. The higher the number, the worse the economic performance is. The five levels are as follows, in descending order of deprivation: Distressed, At-Risk, Transitional, Competitive, and Attainment. The ARC defines Distressed counties as those that are the most economically depressed, ranking in the bottom 10% of the United States' counties. At-Risk counties rank between the bottom 10 and 25% of the nation's counties. Transitional counties are just as the name suggests, making a transition between a strong and weak economy, ranking between the bottom 25% and the top 25% of the country's counties. Competitive counties have the potential to compete with the strongest economies, but they are not quite at the top of the list as they rank between the top 10% and 25% of counties. Finally, Attainment counties are the most stable economies which rank among the top 10% of the country's economies (Appalachian Regional Commission 2017).

Data for unemployment rates between 1990 and 2017 were downloaded from the Bureau of Labor Statistics' Local Area Unemployment Statistics database. These years were chosen in order to accurately reflect the progression of the crisis using the available opioid data. Both the unemployment rate and the labor force participation rate were evaluated as potential indicators because they provide distinct, yet meaningful data about the community. Unemployment accounts for those who are actively searching for a job in the past four weeks and are available to work (U.S. Bureau of Labor Statistics). This does

not include people who have given up on searching for employment altogether, even though they are out of a job and wish to be employed. Thus, the unemployment rate is the number of unemployed persons as a percentage of the total labor force (sum of all employed and unemployed persons). The labor force participation rate is the labor force as a percentage of the total civilian noninstitutionalized population (aged 16 and older excluding active duty military personnel, inmates of both prisons and psychiatric hospitals, or retirement homes) (FRED 2020). The labor force does not include people who are neither employed or unemployed, such as students, retired people, or those who are not seeking work. I decided to use unemployment rates since they are more frequently mentioned as a driving factor for opioid use in relation to the crisis (Dean and Kimmel 2019; Dasgupta, Beletsky, and Ciccarone 2018) and they are included as a measure in the calculation of the Appalachian Regional Commission's county economic classifications.

The availability of primary care and mental health providers in a county is the next indicator explored. These are provided by County Health Rankings and Roadmaps, a program that reports health statistics, data, and comparisons from various sources which allows local communities to identify areas in which they can improve. The database collects the information on primary care providers from The Area Health Resource File and the American Medical Association, while the mental health care provider data is from the Centers for Medicare & Medicaid Services. The most recent data available for the indicators is from 2018. The two measures that will be used in this investigation are reported as ratios that represent the "number of individuals served by one mental health provider [or physician] in a county, if the population were equally distributed across

providers", with the numerator of the ratio being the number of mental health providers or primary care physicians in the county and the denominator side is the total county population (County Health Rankings and Roadmaps, 2020). Therefore, the left side of the ratio is the number of people served by one physician. County Health Rankings and Roadmaps defines mental health providers as "psychiatrists, psychologists, licensed clinical social workers, counselors, marriage and family therapists, and mental health providers that treat alcohol and other drug abuse, as well as advanced practice nurses specializing in mental health care", while primary care providers are defined as "practicing non-federal physicians (M.D.s and D.O.s) under age 75 specializing in general practice medicine, family medicine, internal medicine, and pediatrics." The ratios are mapped in descending order, meaning in theory the higher the first number is (which indicates less accessible healthcare providers), the worse off the community is.

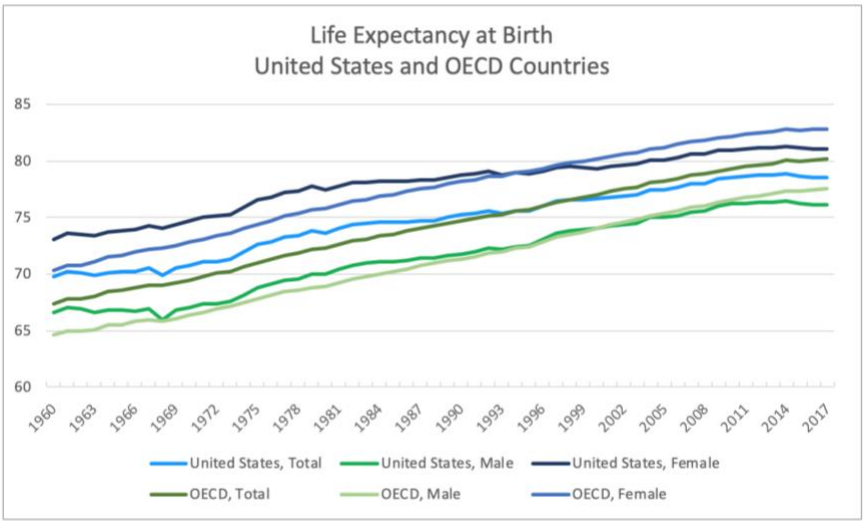
The final indicator that I will explore is educational attainment, which was gathered by the Census' 2013-2017 American Community Survey. Two measures are used to calculate the amount of schooling in a community: the percent of the county population with less than a high school degree for ages 18 to 24 and the percent of the county population with a bachelor's degree or higher for ages 25 years and over. These account for the two ends of the education spectrum, being the lowest and highest levels of attainment.

IV. Exploration of Driving Factors

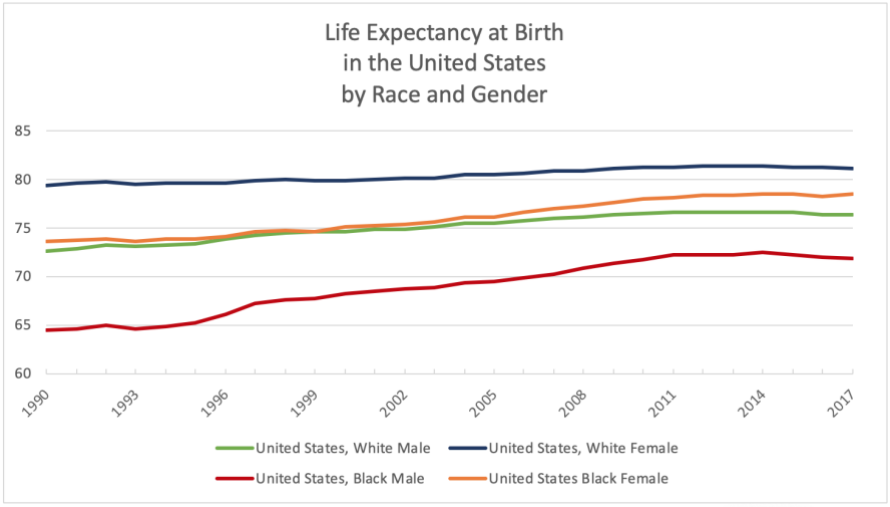
Life Expectancy, Development, and Opioid Use

Despite being one of the most developed countries in the world, the United States has managed to experience the worst drug epidemic in its history. This crisis has caused the life expectancy to decrease for Americans between 2015 and 2017, most noticeable for males, which is especially rare for non-wartime (Dasgupta, Beletsky, and Ciccarone 2018). This measure is the most basic way to determine the health of a society and "declines in developed countries are extremely unusual" (Tavernise and Goodnough 2020). Several studies, most notably the research conducted by Woolf and Schoomaker (2019) on life expectancy and mortality rates, have addressed the driving factors for this decrease, noting drug overdoses, alcohol liver diseases, heart diseases, suicide, diabetes, motor vehicle accidents and homicides as some of the key causes, however this thesis will focus on the effects of opioid-specific drug poisonings.

Life expectancy is the first measure to address as it shows the effects of the usage of opioids over time on the entire country. Beginning in 2014, there is a slight decrease across all measures, however the point of focus will be on white males, as this is the population that the literature suggests is at the greatest risk for lower life expectancies by cause of opioids.

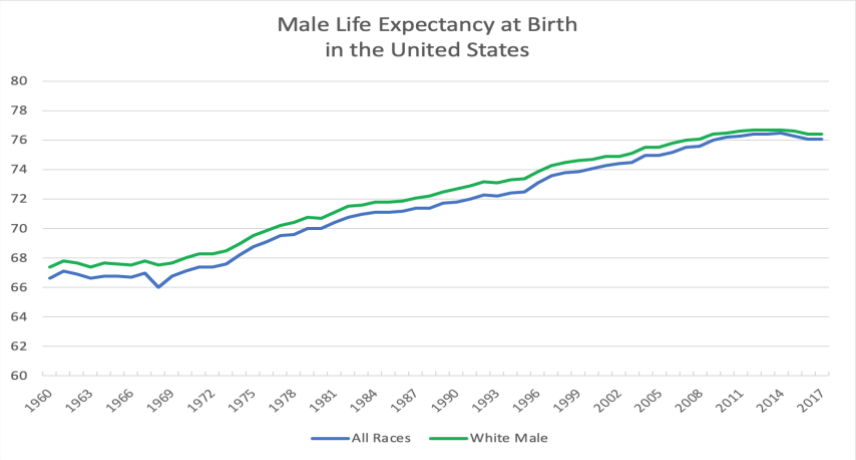


For men of all races and ethnicities, there is an apparent decline in life expectancy after 2014 which then continued to decrease or remain stagnant. The most recent year of data, 2017, suggests that a male in the United States is predicted to live 76.1 years, compared to the OECD male average of 77.53. US females are predicted to live a full five years more than their male counterparts. The average for both men and women in the US is 78.54, while the OECD average is 80.14. Here is the breakdown by race for white men, white women, black men and black women.



While the decline appears very slight, the point of emphasis is the fact that this three-year period is the longest consecutive decrease in predicted years of life in this dataset, as the rate for all men experienced a decline over a two-year period between 1961 and 1963.

The following graph highlights life expectancy at birth for all males compared to white males living in the United States between 1960 and 2017.



Woolf and Schoomaker's paper on life expectancy and mortality rates explains the racial difference between the decline in life expectancy, stating that these rates were initially worse in white populations in part due to "their greater access to health care (and thus prescription drugs)" in terms of opioid overdose deaths (2019, 2009). This follows the popular narrative of how the opioid crisis has affected this country and what groups have struggled, but the authors acknowledge that it does not fully account for the increase in mortality rates. There is additional literature that suggests the crisis is only a small factor in a much bigger overall health decline and whites are not the only group that are experiencing the consequences. Muennig, Reynolds, Fink, Zafari, and Geronimus (2018,

1626) posit that the deteriorating health of this country is not "confined to Whites" and that it is not solely attributable to the opioid crisis as this decline was bound to happen. The authors explain how the aforementioned driving factors of mortality are also at play and the attention given to white people during the opioid crisis is distracting from the structural flaws of society that have an impact on all Americans (2018, 1626). They do, however, recognize the reasons for why the opioid crisis has behaved in the concentrated manner that it has.

Recent studies have provided a source of hope for the outlook of the health of the American people. A *New York Times* article (Tavernise and Goodnough 2020) revealed the findings of an increase in life expectancy for the first time in four years and while this positive news is necessary for a country in times of despair, it should be put into context. The slight rise in 2018 has merely put the United States back to its 2010 levels "amounting to nearly a decade of stagnation, rare for a wealthy country" as Dr. Samuel Preston, a demographer at the University of Pennsylvania, notes in the *Times* article.

There are several important driving factors for the increase in mortality rates and the decrease in life expectancy that must be understood, but I will analyze the role that the opioid crisis has played independently. In terms of the crisis itself, there are many layers and variables that contributed to the declines in health. While this drug epidemic is not a problem entirely unique to this country, the rate at which Americans are consuming and overdosing on opioids far outpaces that of other countries. When comparing regions within the country, the rates become even more startling. In an effort to explore the crisis in more depth and provide an explanation for the factors that have potentially exacerbated

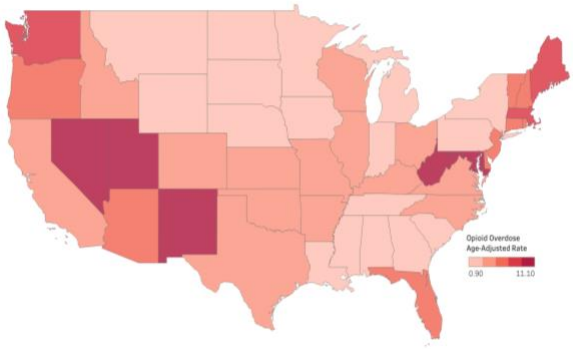
the magnitude of it, I will use theories from the current literature to build upon my arguments using my own data and visualizations. Using maps at the national and county levels, I will convey how the epidemic has expressed itself in the United States. An economic, geographic, development and structural lens will be applied to better understand the reasons why opioids have played such a substantial role in this country for nearly the past 25 years.

While there have been three waves of the crisis that have affected the course it has taken and the intensity at which it has claimed lives, this thesis will explore variables that are applicable throughout the entirety of the epidemic. There have been numerous attempts to reason through the crisis and determine contributing factors by social scientists, economists, and psychologists, most notably Katherine Keyes (2014), Shannon Monnat (2018) Adam Dean (2019), and Khary Rigg (2018). While the exact causes have not been successfully established, several of these explanations will be included in this thesis to breakdown the drivers in a logical manner and make sense of the literature. This paper will not test a specific hypothesis since there is a lack of consensus amongst researchers as to which variables should be controlled for. Instead, it will look at the crisis through the lens of several descriptive variables that are present in the literature as potential drivers. The most commonly disseminated and accepted reasoning for the start and continued rise of the crisis is attributed to opioid prescription practices. While this undoubtedly has had adverse effects on communities across the country, I believe there is a reason as to why certain groups of people were more vulnerable to the epidemic than others.

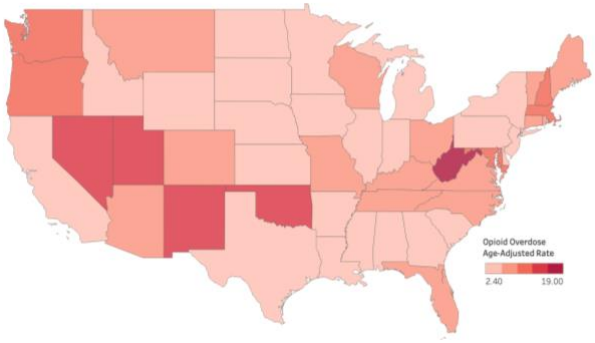
Changes in Opioid Abuse at the State Level: 2002-2017

Opioid use in the United States has affected different demographic groups in unique ways, however in an effort to explore which people and region of the country were most significantly impacted, I will first study the crisis over a 15 year period at the state level through maps, followed by county level data for the most recent five years of data available. The global perspective allowed the crisis to be understood in terms of the United States as a developed nation compared to other high-income countries and to the rest of the world. Within the country, the trends over this time period, in terms of race and ethnicity, sex, socioeconomic status, and structural composition will help explain the full impact of the crisis and its future. Below are maps of opioid overdose age-adjusted death rates per 100,000 people at the state level for both sexes and races over five-year increments using data gathered from the CDC's Multiple Cause of Death database.

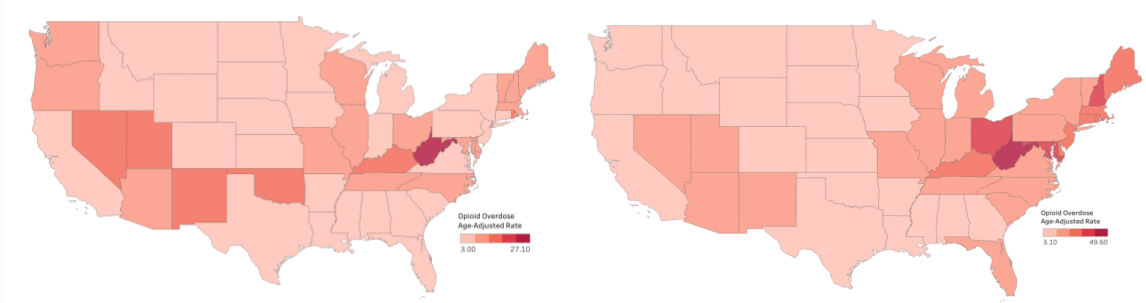
2002



2007



2012 2017



It is important to note the different legend values to accommodate the significant increase and variation in overall rates across all states. The dark red states indicate high opioid death rates, and the change in concentration throughout the country can be seen over the 15 years. In the first year of data collection (2002) New Mexico is the state with the highest rate with 11.1 overdoses per 100,000 people, while West Virginia is right behind with 10.1. Five years later in 2007, West Virginia had the highest rate with 19 deaths, again in 2012 with 27.1, and finally 49.6 deaths per 100,000 people in 2017. The Southwest and Western regions of the country were originally the areas of most concern, however as West Virginia started to consistently lead the country in opioid deaths from 2010 onwards, the rest of the Appalachian Region suffered alike, and it quickly became the region to focus on.

Opioid Abuse: A Breakdown by Demographics

The discussion of demographic groups includes the ways in which people of different races and ethnicities have been affected. This plays an interesting role in the crisis because of how contrastingly different this epidemic is portrayed compared to others and the group of people it is affecting the most. In previous drug epidemics, specifically the most recent crack cocaine problem of the 1980s and 1990s, the main

users were minorities (black or African American and Hispanic or Latino) and they were depicted by the media as criminals or addicts in urban areas. On the other hand, the opioid crisis is characterized as a rural white male's problem, who are also the victims of unethical pharmaceutical practices (T. Santoro and J. Santoro 2018). While the purpose of this thesis is not to explain the systematic problems that exist in society which have led to this difference in portrayal, the comparison of overdoses by race and ethnicity is part of the story.

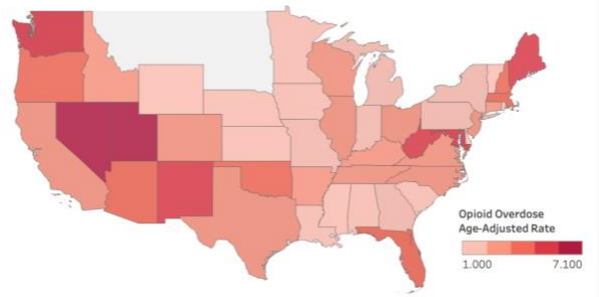
The opioid crisis is portrayed as primarily a white man's problem, which is supported by my data, but women and opioid users of other races and ethnicities are not immune to opioid abuse. Men have historically had higher rates than females across all states and years, sometimes nearly double as seen in West Virginia in 2017 whereby the rate for males was 65.2 and females was 33.8, but both rates were significantly higher than the national averages for that year which were 20.4 and 9.4, respectively. Men saw an overall national increase of 258% between 2002 and 2017, while the increase for women was 261%. With respect to prescription opioids, women are twice as likely to be prescribed them compared to men, however men are more likely to use opioids in a nonmedical manner (Mazure and Fiellin 2018, Baker 2019). Despite the fact that the prescription opioid death rate is higher for men than women in the country, the rate has increased more in women than men; between 2002 and 2017, the increase for women was 162.5% and 110% for men (National Institute on Drug Abuse 2020).

The implications of opioid use disorders differ between men and women, therefore even though women might have lower rates, they are affected differently and

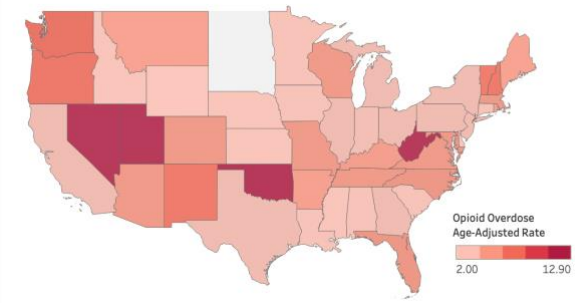
more substantially. Below are maps of opioid overdose age-adjusted death rates per 100,000 people at the state level broken down by sex (of all races and ethnicities) over these same five-year increments. Several states do not have available data, but due to the fact that all of the states in the Appalachian Region have reportable values each year, the maps were visualized as individual years.

Female:

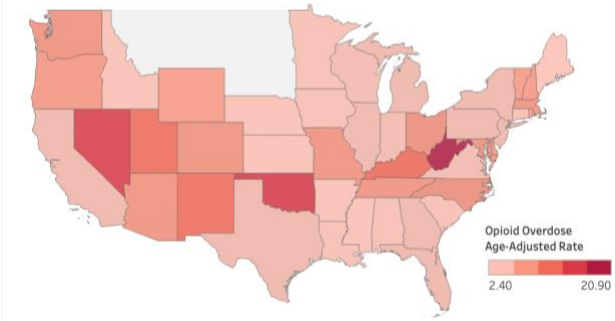
2002



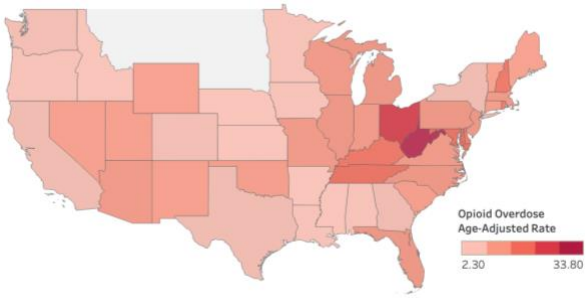
2007



2012



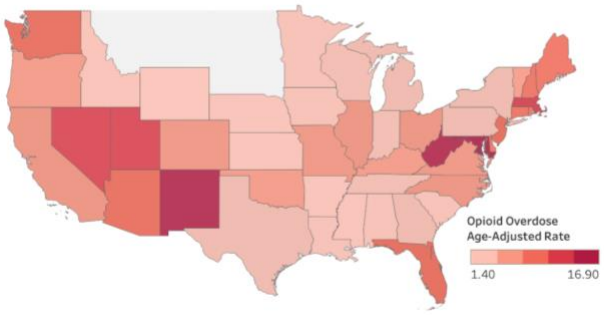
2017



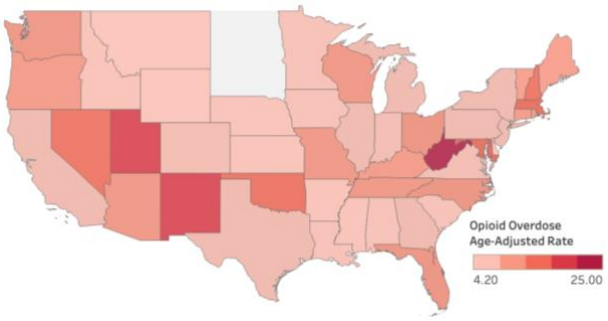
Note the difference in legends in order to visually see the state-to-state variation each year. In 2002, Utah had the highest rate for females with 7.1 overdoses per 100,000, while from 2006 onwards, West Virginia had the highest rates for females; 12.9 in 2007, 20.9 in 2012, and 33.8 in 2017.

Male:

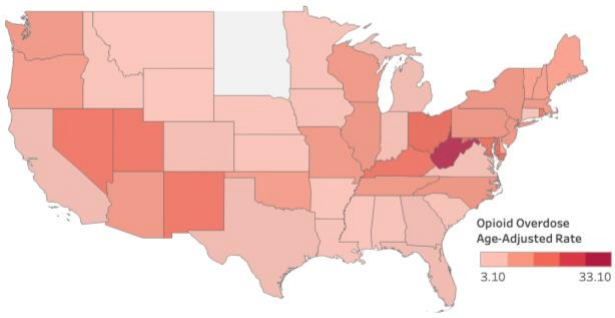
2002



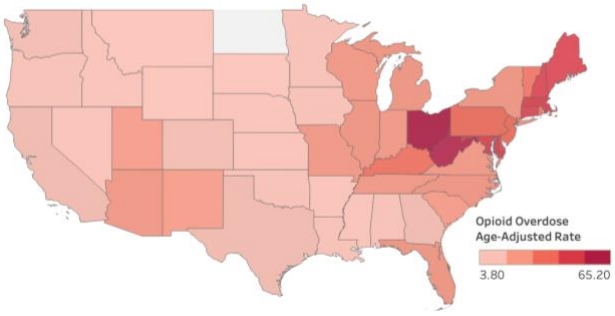
2007



2012



2017

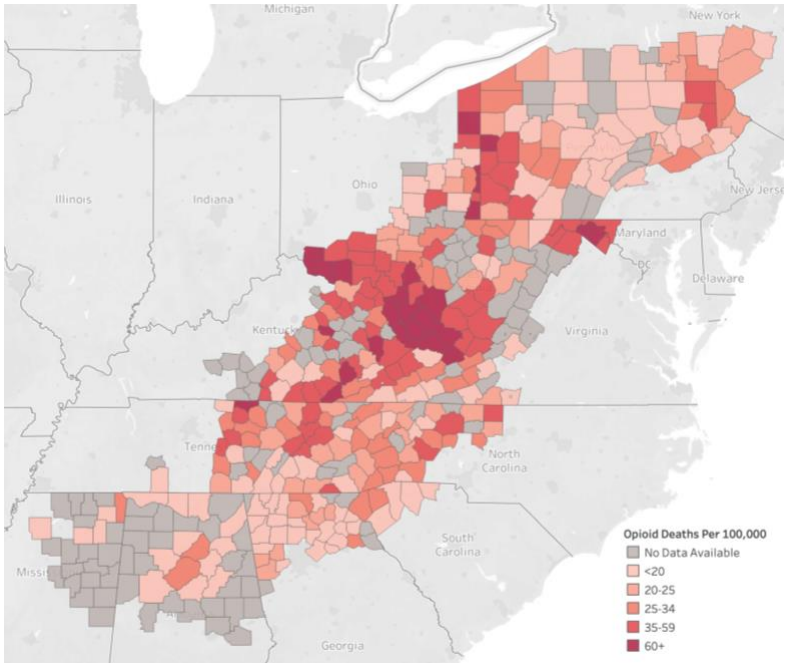


For males, New Mexico had the highest rate in 2002 of 16.9, and as with women, from 2006 onwards (with the exception of 2009), West Virginia had the highest rates for men; 25 in 2007, 33.1 in 2012, and a startling 65.2 in 2017. Again, note the different legends for visualization purposes and the states in gray which indicate no available data.

The limitation of data available at the county level for the various disaggregations by demographic groups posed as an obstacle in analyzing the relationship between the other variables being studied in this thesis. While the national and state level data provide an idea of the impact, the opioid overdose rates at the county level will be for both sexes and races and ethnicities.

County-Level Case Study: The Appalachian Region

The state-level maps cannot provide a complete picture of the crisis over this time period, however they serve as a starting point to locate the area of further investigation for this thesis. The map below shows a county level map for the opioid overdose death rates for all counties in the Appalachian Region with available data between 2013 and 2017.



The Appalachian Region in particular suffered a disproportionate amount from globalization compared to the rest of the country because of the composition of its economic sector. Additionally, there are several structural challenges that are a result of the numerous rural counties in the region. The concentration of rural counties in the region supports the narrative that people living in these areas were left behind as the country experienced globalization, allowing opioids to play a larger role in the region. The ability for these communities to keep their people afloat has diminished and “many

of the institutions that have long protected low-income Whites from abject poverty are now disappearing, particularly in those states and counties with the highest increases in mortality rates" (Muenning et al. 2018). For this reason, many nonprofits and nongovernmental organizations (NGOs) are beginning to shift their focus to rural America as it is often overlooked compared to urban communities in terms of poverty solutions. The lack of resources in these rural areas combined with the obstacles present in accessing the social programs and benefits that are available because of remoteness has made these towns suffer more intensely. The attention that the opioid crisis has brought to rural America has encouraged politicians, the media, and researchers to concentrate their resources and energy there (Rigg, Monat, and Chavez, 2018, 119). With regards to politicians, they are increasing their campaign efforts in rural communities to give this population a bigger voice in the politics that affect them. They are also addressing the issues that have been raised by the opioid crisis in rural America in their policymaking, but there is much more work to be done on this front. Researchers have been studying the opioid crisis for quite some time and have explored the trajectory of the epidemic in rural areas versus urban areas. Due to the increased attention and research in rural America, the Appalachian Region will be used as the county level case study as it possesses the characteristics that are thought to contribute to the unparalleled opioid consumption and overdose rates.

The infrastructure of the many rural communities in the region can be understood by studying indicators from various dimensions. In this thesis, I will look at socioeconomic and geographic variables, all of which will be addressed in individual

subsections. Socioeconomic indicators include educational attainment, changes in the employment sector that dominate the Appalachian communities, and the aforementioned classification system of counties based on economic hardship. The geographic side will focus on population density measured by the 2013 NCHS Urban-Rural population classification, as well as access to quality healthcare. Together, these indicators can provide an explanation of the driving factors that have led to the increase in opioid usage in the Appalachian Region.

In my thesis, I recognize the common narrative of over-prescribing practices of opioids and I understand the impact they have had on the crisis, but I argue that they fail to tell the whole story. While it is evident that the areas with high rates of prescriptions have also had high rates of overdose deaths, as seen in the maps below, there are other structural factors that I will address in order to contribute more to the story.

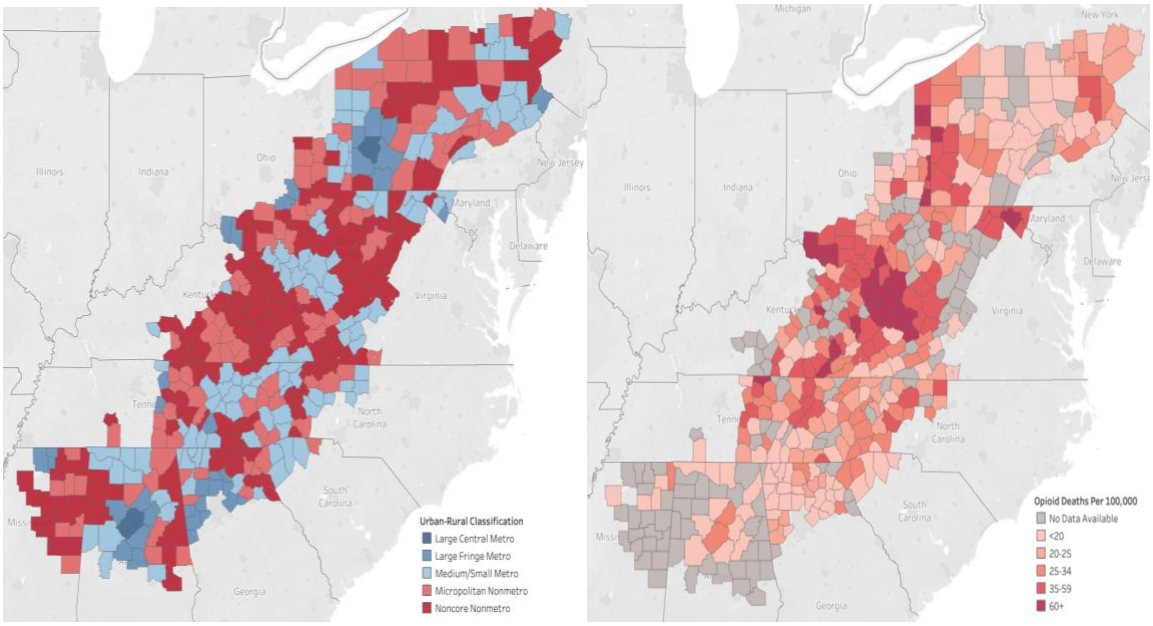
There are factors that lead people to seek out these drugs in the first place and to continue using them beyond their recommended dosage. However, the impact that economic conditions have on drug use is incredibly important as they explain the ways in which people cope with hardships in this country. The socioeconomic and environmental factors of rural areas have allowed the opioid crisis to behave in such a concentrated manner. There is a great deal of inconsistencies in the literature surrounding opioid use in rural versus urban areas, mainly due to the variance in reporting of national versus state and county level trends, all of which this thesis is attempting to address. Additionally, depending on if the study takes a longitudinal approach and addresses changes in use over time or simply the current absolute rates, the reporting will differ. As previously

mentioned, Rigg, Monnat, and Chavez (2018, 119) explain the variability of opioid use between rural areas across the country, noting that these rates were significantly lower in the Great Plains and the Delta South when compared to the Appalachian Region, Mountain West, and New England. Within Appalachia, the central region (including North Central, Central, and South Central) is the most rural, consisting of West Virginia, Eastern Kentucky, Southeast Ohio, Southwest Virginia, Northeastern Tennessee and Western North Carolina. These are the coal mining states that have long histories of physical laborers, leading to chronic job-related injuries and pain, inducing the need for pain relievers. Despite the fact that there are some conflicting arguments that suggest opioid use, specifically prescription, is not unique to rural areas and is actually higher in certain non-rural counties, there are substantial evidence and data to support the idea that this aforementioned composition of rural communities facilitates drug use (Keyes et al. 2014).

Rural-Urban Divide

The rate at which opioid death rates in rural areas increased over the past two decades is much greater than that in urban areas. In two of Monnat and Rigg's studies (2018), they quantify this increase using the years 1999 to 2016, amounting to alarming values. The percentages differ slightly between the two works, but this is due to the differences in Urban-Rural Classification Scheme for Counties used (2006 versus 2013). In order from most urban to most rural, the approximate values are a 158% increase in Large Central Metro counties, 507% increase in Large Fringe Metro counties, 429%

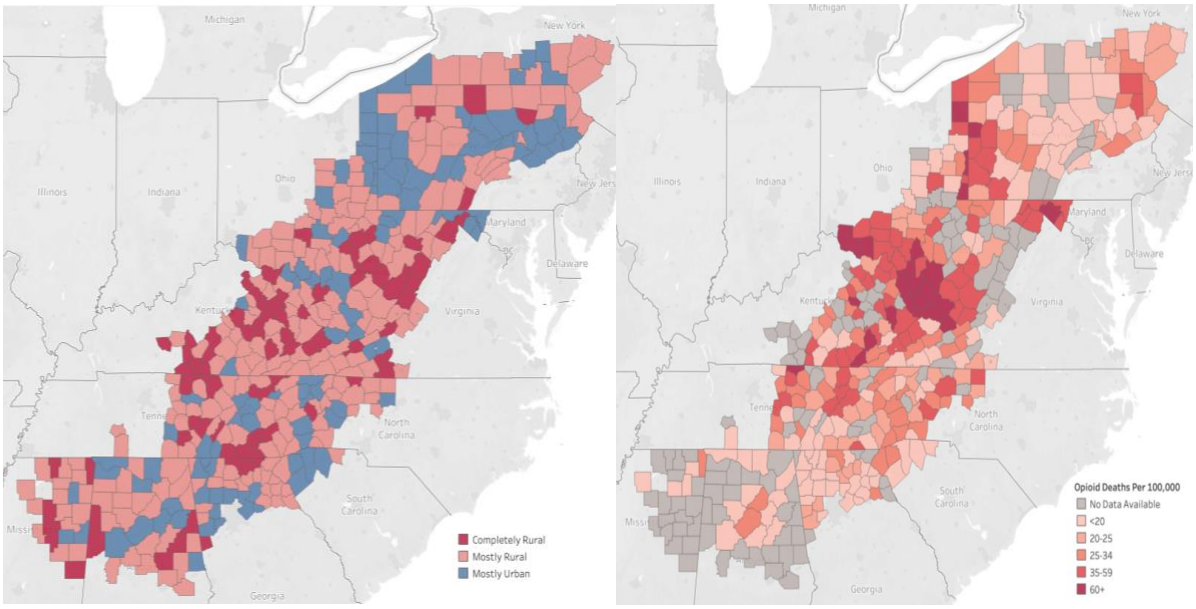
increase in Medium/Small Metro counties, 682% increase in Micropolitan Nonmetro counties, and a 721% increase in Noncore Nonmetro counties (Rigg, Monat, and Chavez 2018, Monnat and Rigg, 2018). The authors warn that these national trends obscure essential differences on the micro level between regions, states, and counties, however the focus is just on the Appalachian Region and the breakdown of county types can be seen below. The map is of the Appalachian Region using the 2013 NCHS urban-rural classification for the counties compared to the opioid map.



To put this into perspective, the Appalachian Region has two Large Central Metro counties, 35 Large Fringe Metro counties, 116 Medium/Small Metro counties, 97 Micropolitan Nonmetro counties, and 170 Noncore Nonmetro counties, as shown in the map above. Out of all the counties in the Appalachian Region, 64% are considered rural. There is a large cluster of Noncore Nonmetro counties in Kentucky and West Virginia as well as Mississippi, shown by the dark red color. The areas that are most rural tend to be

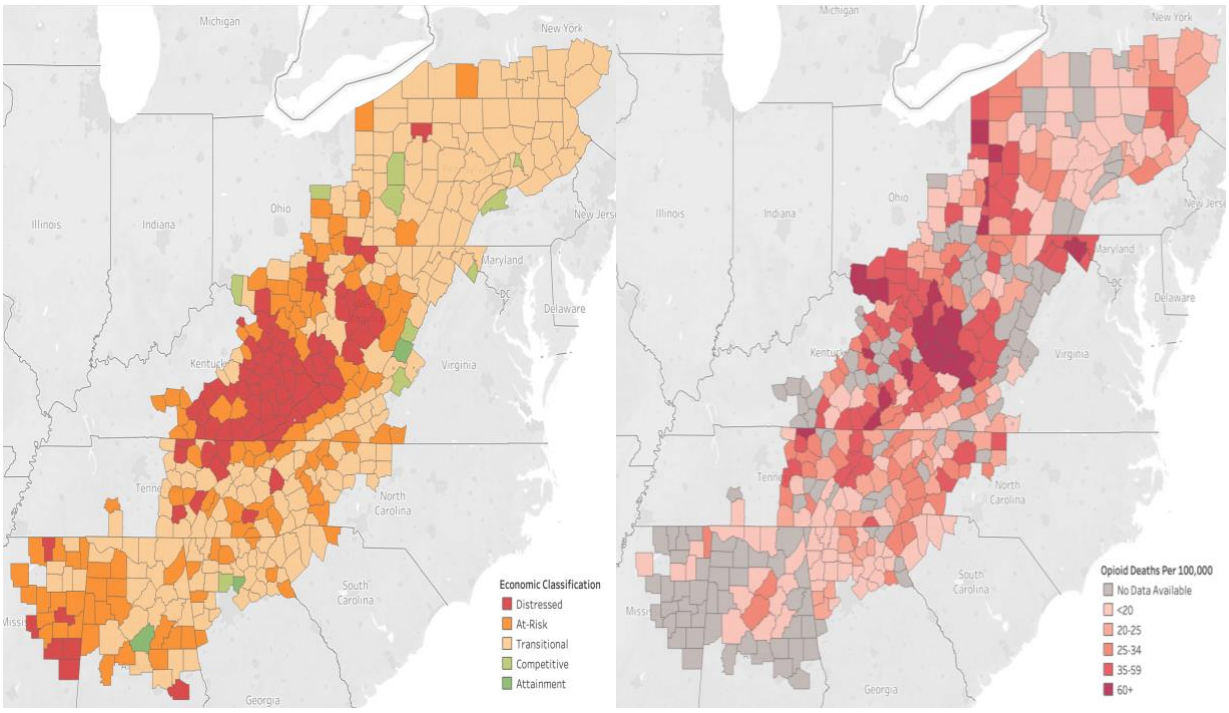
further removed from social networks leading to isolation, healthcare settings, and opportunities for meaningful economic activity (Zoorob and Salemi 2017). While the urban-rural divide alone is not enough to explain the factors that have contributed to opioid use, it supports the discrepancy in the areas which have been hit the hardest by the opioid crisis.

According to the Census' method of classifying rurality, 40% of counties in the US are mostly urban, 38% are mostly rural and 22% are completely rural, while the Appalachian Region has 26% of its counties considered mostly urban, 54% mostly rural and 20% completely rural. The following map visualizes this breakdown in which the large number of rural counties in the region is evident.



Based on the Appalachian Regional Commission's county economic classification system, there is a concentration of Distressed counties in Kentucky and West Virginia, following the pattern of the location of rural counties. As seen in the map below, the dark red counties are those that are Distressed (80 in total), while the counties in dark orange

are At-Risk of being Distressed (110 in total). The majority of counties are Transitional (217) while only 10 are Competitive and 3 are Attainment.



While most Distressed counties are Noncore and Micropolitan, there are a few exceptions to this rural county-economic distress correlation. There are six counties that are considered Medium/Small Metro, and one is considered Large Fringe Metro. The three attainment counties in the Appalachian Region are St. Clair County in Alabama, Forsyth County in Georgia, and Bath County in Virginia. St. Clair and Forsyth are both Large Fringe Metro counties, or suburbs, but Bath County is considered a Noncore Nonmetro county with a population of a mere 4,292 people making it the second least populated county in the state.

The opioid overdose death rate for the region follows a similar pattern. In West Virginia, the five counties with the highest overdose death rates between 2013 and 2017

are as follows: Cabell County with 132.6 deaths per 100,000 people, McDowell with 111.4, Wyoming with 106.8, Wayne with 105, and Mingo with 97.6. All but Cabell County are considered mostly rural and either Distressed or At-Risk economies. The average rate for the dataset is 30.3 deaths per 100,000 people and West Virginia has 31 of 40 available Appalachian counties with rates above this value, just over half of which are Distressed or At-Risk and just under half are Noncore or Micropolitan. In Ohio, 16 of 28 counties are above the average, about 70% of which are Distressed or At-Risk with 63% being Noncore or Micropolitan. Kentucky has 24 of 35 counties above average; 23 are Distressed or At-Risk and 21 are Noncore or Micropolitan. Fifteen of 42 Tennessee counties are above average; half of which are Distressed or At-Risk with only 4 being Noncore or Micropolitan.

The relationship between rurality, economic distress, and high opioid use in the Appalachian Region is one of the reasons this area of the country was chosen as a case study. The socioeconomic factors of the people living in the Appalachian Region are necessary to understand why this area has experienced overdose rates of such great magnitude and why it was the target of pharmaceutical companies' marketing tactics. The following discussion addresses changes in the region's job sector and the implications of unemployment in relation to opioid abuse.

Composition of the Region's Employment Sector and the Implications of Job Loss

The effects of job loss or unemployment can be devastating to a community, especially when there is a centralization of a specific industry. Analyzing the composition

of the workforce is important in order to provide a comprehensive explanation of the crisis. There is a great dependence on manufacturing jobs, which leads to job-related injuries and makes workers vulnerable to globalization and economic downturns, all of which are thought to lead to increased drug use (Dean and Kimmel 2019). Several studies have been conducted that observe the relationship between drug use and certain economic factors, such as labor force composition and unemployment. In Maguire, Miranda and Winter's 2019 study entitled "The Opioid Crisis in Appalachia: The Effect of Blue-Collar Employment", the focus is on opioid prescription rates between 2014 and 2016 in the Appalachian Region compared to the rest of the United States attempting to explain how blue-collar employment affects these rates. They found that there was a statistically significant correlation between these two variables in the Appalachian Region, but not across all states. While they did not conclude what accounts for this difference between this one part of the country compared to the rest of the states, the findings from other studies provide valuable insight.

The authors controlled for potential intervening variables, namely race (non-Hispanic Whites), sex (male), uninsured rates, and median household income, however according to Dean and Kimmel (2019), job loss on the part of globalization had a significant impact on the Appalachian Region. Automation and relocation have affected several areas of the country because workers are being replaced by technology or companies are outsourcing their work to other countries. However, the authors show that factory shutdowns due to international trade have been concentrated in Appalachia. Between 1999 and 2015, the region suffered 16% of trade-related job losses and at the

county level, they show that opioid overdose was greater in counties with higher levels of such job losses (Dean and Kimmel 2019).

Several examples of communities relying on manufacturing jobs are provided in the literature, the first to note is the Monongahela Valley of Pennsylvania located in Washington County, part of the Appalachian Region. The source of employment for this area was the steel factories, but when they closed in the years prior to the opioid crisis taking off, the entire region suffered (Zoorob and Salemi 2017). The rate of opioid related deaths in this county between 2013 and 2017 was 54.4 per 100,000 people. Additionally, North Carolina has historically been the country's main furniture producer, providing a substantial source of employment for its people dating back hundreds of years. As of 2019, this industry employed 35,378 people, a near 10% share of the nation's total. In a study conducted by The North Carolina Rural Economic Development Center, it was found that rural counties in the state comprise nearly 50% of employment in the furniture manufacturing sector (Poole and White 2013, 10). Two of the top five leading furniture-employing counties in North Carolina are in the Appalachian Region, Alexander and Caldwell Counties, with 2,460 and 1,887 employees for 2019, respectively according to the Bureau of Labor Statistics. The reliance on one industry in certain areas makes workers especially susceptible to globalization, leaving them with few other options when economic obstacles arise.

With the relocation of many companies abroad, including the outsourcing of jobs and increased competition by foreign manufacturers, the region has suffered tremendously. The aforementioned study classified the furniture industry statewide,

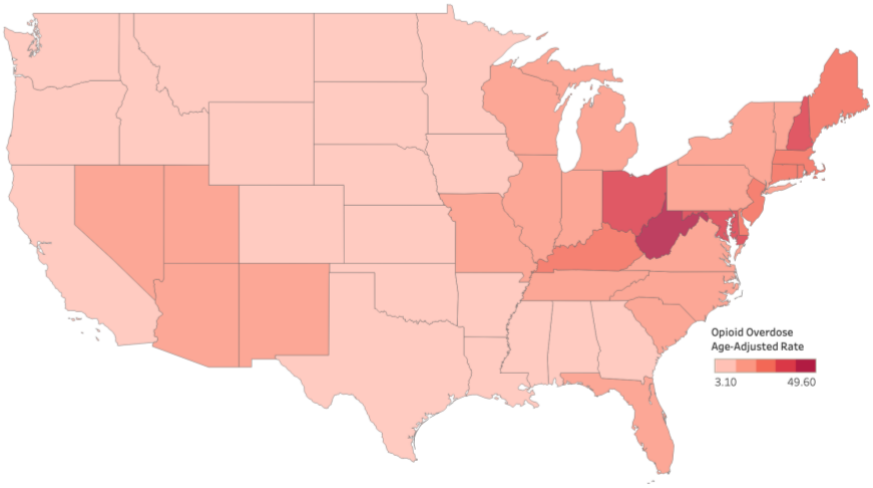
across all rural counties, and Appalachian counties, as at-risk, meaning it has "sustained significant employment losses, often at a rate faster than the corresponding national cluster" (Poole and White 2013, 7). The abundance of low-skilled manual labor jobs made them available to all people regardless of their educational attainment or expertise. With the foreign competition that has threatened the local industries, they have been forced to switch gears to produce customized, more up-scale pieces, which necessitates higher-skilled and specialized workers. This type of employment is much less accessible to the people living in these areas.

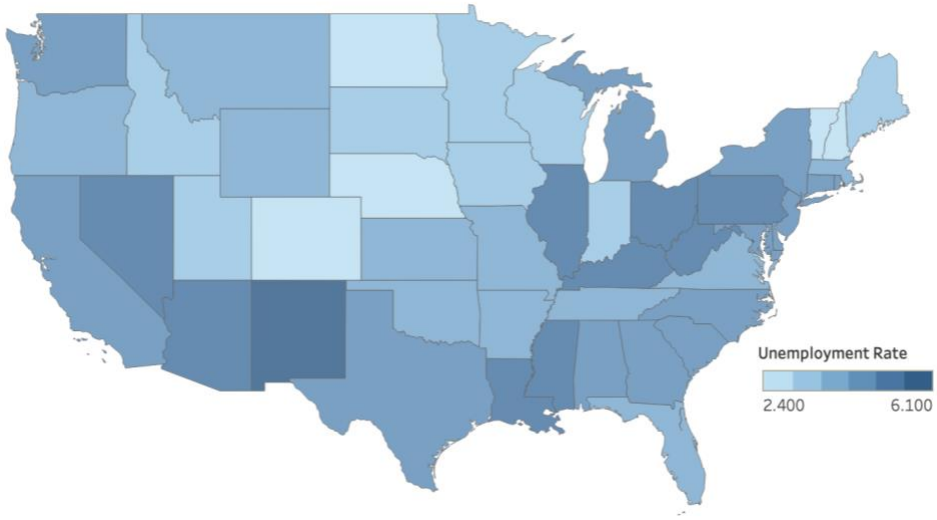
The final focus of manufacturing jobs is in the coal industry which has been declining across the United States and has caused significant losses in employment for residents of the Appalachian Region, specifically the central subregion. In a report commissioned by the Appalachian Regional Commission, Bowen, Christiadi, Deskins, and Lego (2018) quantify this decline over a 10-year span between 2005 and 2015. The total coal production in the country, most of which can be accounted for by the Appalachian Region's production, fell nearly 21%, while the region experienced a 45% drop itself. Broken down by subregion, central Appalachia's production dropped 61% over the ten years, southern Appalachia's production decreased by 38%, and 16% for northern Appalachia. With the decreased demand for coal comes a decreased need for employees, thus shrinking the economic activities in these communities. Coal mining employment in central Appalachia went from 32,700 to 19,600 between this time. This report also found that the counties that experienced the most coal production losses were

the ones that depended the most on these coal-mining jobs, causing considerable economic stress on the local economies and its residents (Bowen et al. 2018, 19).

These low-skilled manual labor jobs provided profitable employment that were respectable to the skill levels that these workers possessed. In the event that they lose their job, their ability to find another job, specifically one with a comparable salary, is diminished. Unemployment of any amount of time has significant implications on the physical and mental health of people. It increases feelings of depression and hopelessness and since people do not have their jobs to occupy them and provide them with a sense of security, they often turn to drugs, whether their addiction begins on purpose or inadvertently. Opioid use may begin following job-related injuries, which are very common in the aforementioned industries, as this would allow individuals to continue working despite the pain. However, when the pain subsides or the worker loses their job, the opioid use becomes non-medical and is likely to continue (Dasgupta, Beletsky, and Ciccarone 2018). The adverse effects of manual labor jobs in the Appalachian Region, namely vulnerability to workplace injuries and job loss have been shown throughout the progression of the crisis.

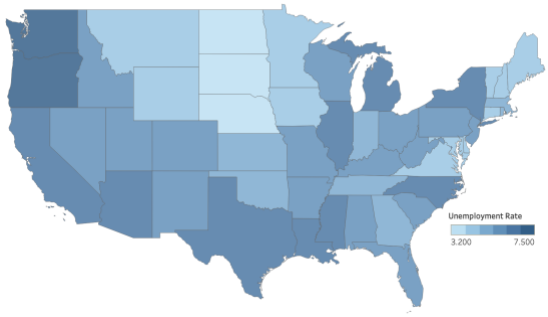
In order to visualize this relationship between job loss, workforce composition, and opioid use, unemployment rates at the state and county level will be compared to opioid overdose rates at the same geographic levels. Below is the map of opioid overdoses of both sexes and races or ethnicities in 2017 and a map of unemployment for the same year.



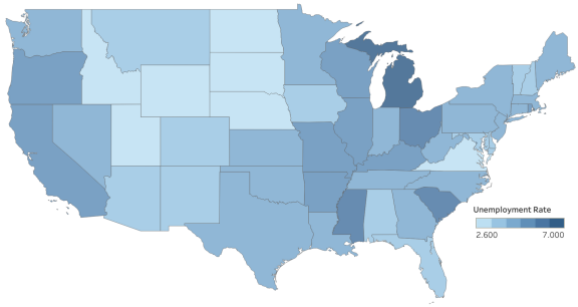


To demonstrate the same 15-year increment that was provided for age-adjusted opioid overdose death rates, the state unemployment rates for these selected years are below.

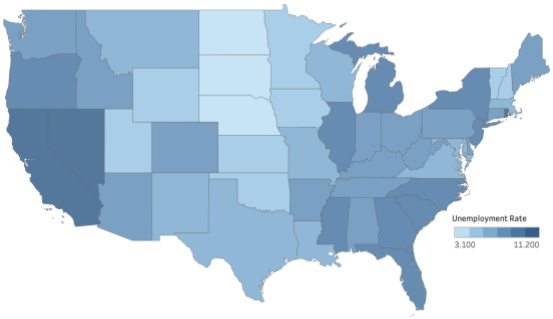
2002



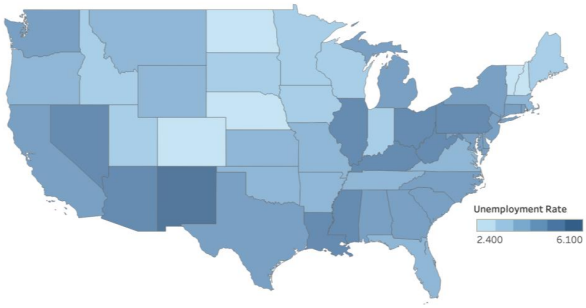
2007



2012

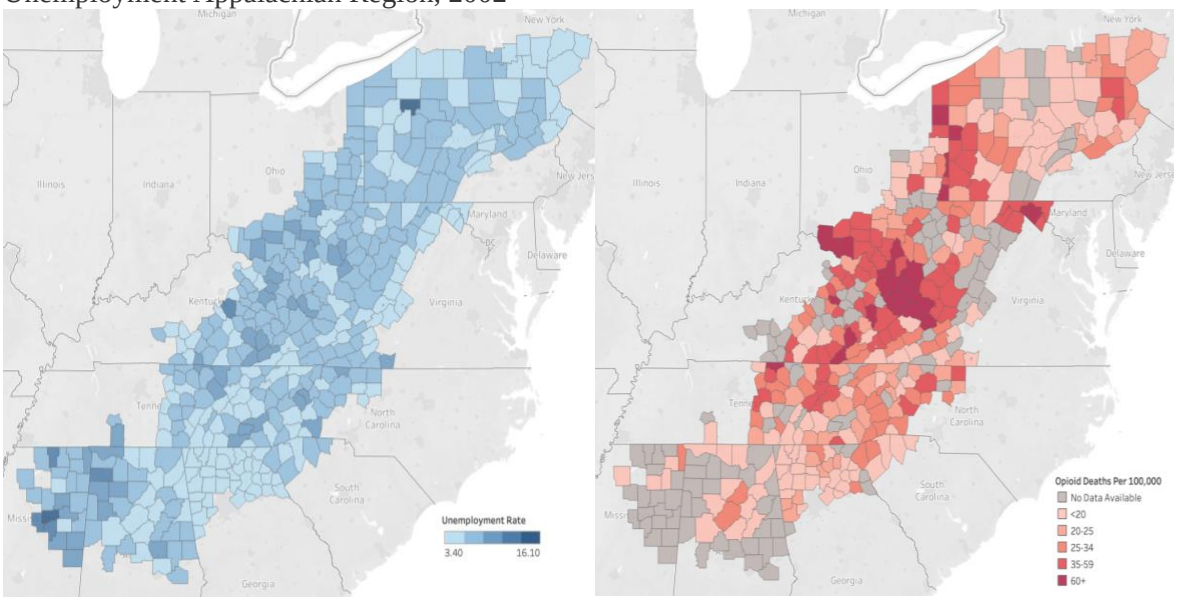


2017

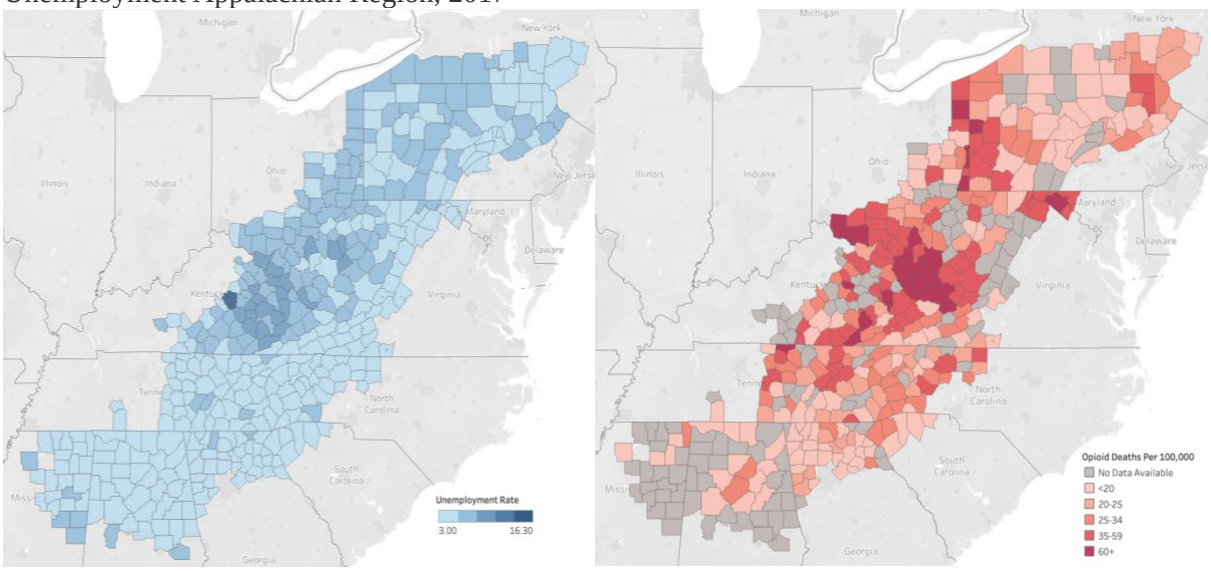


The highest rate of unemployment in the contiguous United States in 2017 was in Washington, DC with a rate of 6.1 compared to a national average of 4.1. 11 of the 13 Appalachian states experienced higher-than-average rates during this year, with Tennessee and Virginia posting rates just below 4.1. As with all of the variables being addressed in this thesis, a deeper geographical analysis can provide more context for the crisis and tell a more accurate story. Below are county level unemployment maps for 2002 and 2017 to show the changes in economic behavior in the region.

Unemployment Appalachian Region, 2002



Unemployment Appalachian Region, 2017



The concentration of unemployment in central Appalachia can be seen above, especially in 2017 after the effects of the aforementioned declining industries began to kick in. It is evident how detrimental unemployment can be to a community, therefore the need for efforts focused on job creation is even more important. The sense of loss amongst residents in communities that are so heavily reliant on certain industries can

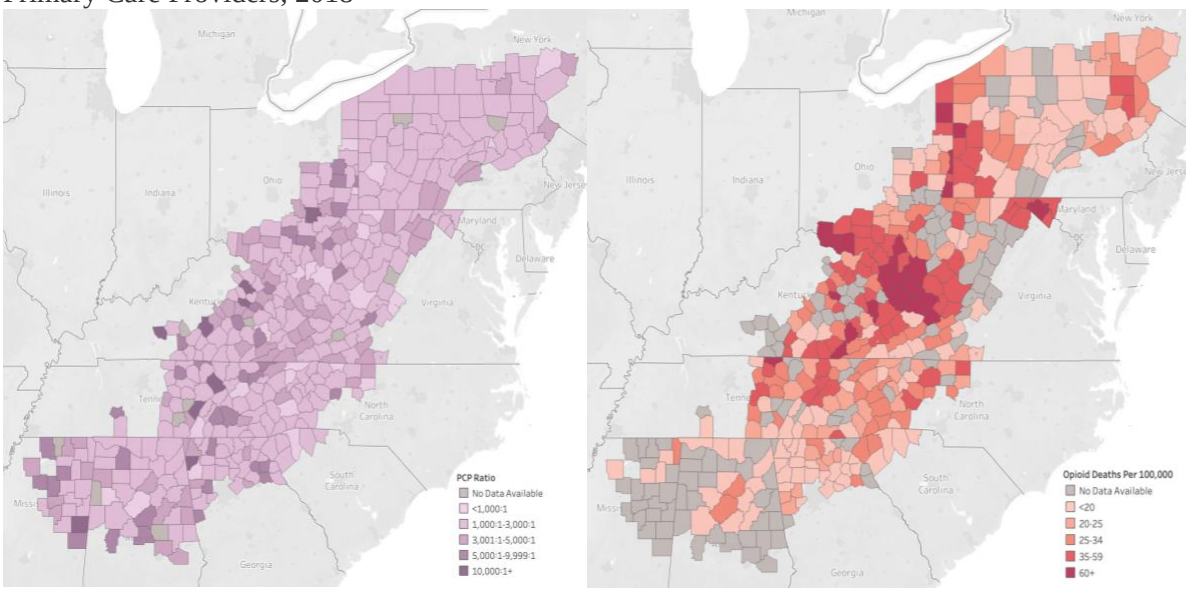
promote a feeling of isolation (Zoorob and Salemi 2017). It proves to be very difficult to recover from the abrupt changes that they must endure during these lifestyle shifts.

Access to Healthcare in Appalachia

As explained previously, another measure of community welfare is the accessibility of healthcare providers, in terms of physicians and mental health professionals. While it might seem that having better access to doctors would increase the likelihood for opioid prescriptions, this would be assuming a causal relationship between the two variables and this thesis did not test causality for the crisis. Limited access to such providers in rural communities is actually considered an infrastructural challenge which contributes to the inability to combat the opioid crisis (Monnat and Rigg 2018). This makes the population very vulnerable to health risks and decreases the ability to treat the opioid use that is present.

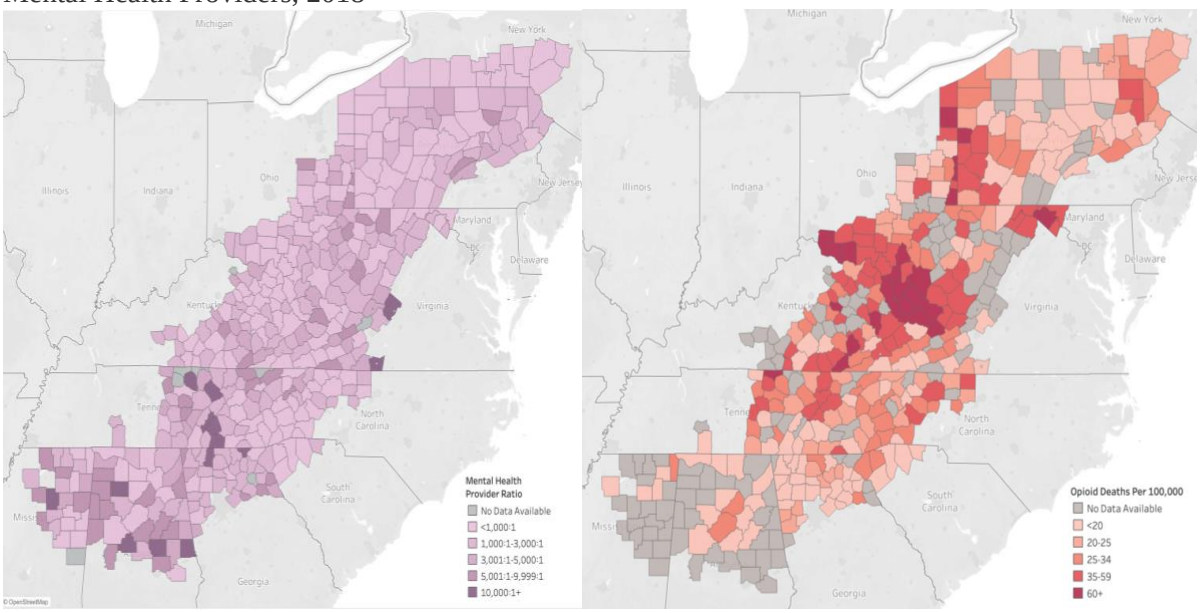
Below are maps of the ratio of the number of people in a county that are served by one primary care physician or mental health provider. The lower the ratio, the more available healthcare is. The darker shades of purple on the map indicate large ratios, signifying a limited number of providers for the population.

Primary Care Providers, 2018



The ratios are <1,000 people to one primary care provider, 1,000-3,000 to one, 3,001-5,000 to one, 5,000-9,999 to one, and finally 10,000 or more to one. The nine counties included in the 10,000:1+ group portrayed by the dark purple in the map in order from largest to smallest ratio, indicating a lack of primary care providers, are as follows: Morgan County, Tennessee (21,550:1), Casey County, Kentucky (15,820:1), Morgan County, Ohio (14,800:1), Bledsoe County, Tennessee (14,680:1), Chattooga County, Georgia (12,410:1), Bath County, Kentucky (12,330:1), Powell County, Kentucky (12,310:1), Edmonson County, Kentucky (12,110:1), and Noxubee County Mississippi (11,040:1).

Mental Health Providers, 2018



The ratios for mental health providers are the same as those for primary care providers. There are fourteen counties included in the 10,000:1+ group as portrayed by the darkest shade of purple in the map. In order from largest ratio to smallest, indicating a lack of mental health providers, the counties are as follows: Macon County, Tennessee (24,080:1), Winston County, Alabama (23,720:1), Rockbridge County, Virginia (22,660), Morgan County, Tennessee (21,640:1), Chambers County, Tennessee (21,640:1), Polk County, Tennessee (16,760:1), Calhoun County, Mississippi (14,490:1), Murray County, Georgia (13,261:1), Meigs County, Tennessee (12,070:1), Towns County, Georgia (11,506:1), Bibb County, Alabama (11,330:1), Overton County, Tennessee (11,010:1), Coosa County, Alabama (10,750:1), and Henry County, Virginia (10,250:1).

Relating back to the discussion of rural areas having a more difficult time accessing the resources they need, the lack of qualified health care professionals that are able to provide the proper treatment for drug users is another obstacle that has threatened

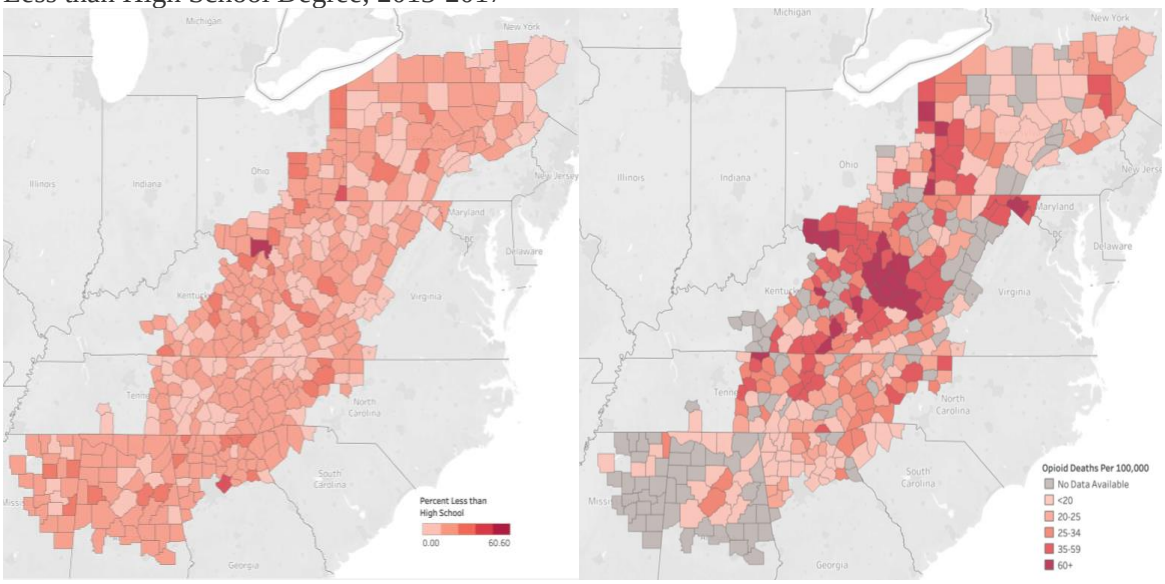
the Appalachian Region. As Moody, Satterwhite, and Bickel (2017) demonstrate, this matter is especially pressing in central Appalachia because of this combination of factors whereby "the rurality of much of [this subregion] may make access to health professionals disproportionately costly, especially for those who are uninsured" and "rural health care providers nationally, including those tasked with treating substance use disorders, may not receive sufficient training in evidence-based treatments" (2017, 4). The authors cite a qualitative study from 2006 which included researchers conducting interviews of ten focus groups in southern West Virginia, five of which were men, five were women. They analyzed cultural norms of rural Appalachian residents, specifically focusing on the social and cultural factors that affect health and illness in the region. The authors found that there was a sentiment of distrust towards healthcare professionals, for several reasons, including a fear that the doctors will prescribe medicine that will lead to addiction, the possibility of personal problems turning public, and the reluctance to build a relationship with a foreign-born physician (Coyne, Demian-Popescu, and Friend 2006, 5). Moody and others conclude that this issue of trust poses another barrier to receiving professional help and treatment and believe that community-led programs to rebuild this trust would improve the situation.

Educational Attainment

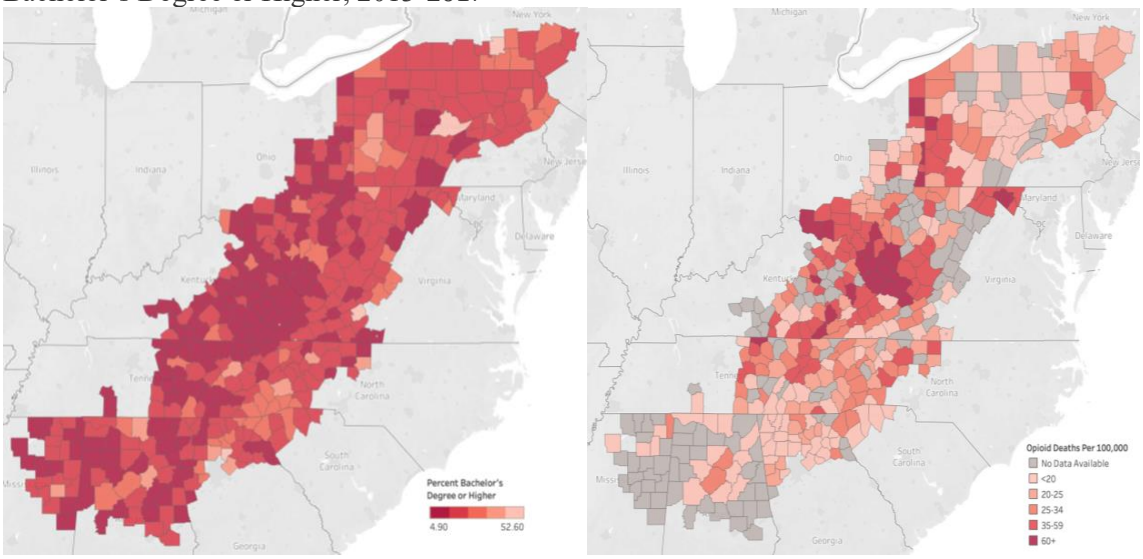
The final socioeconomic welfare measure to be addressed is educational attainment, which is mapped below by the percent of the population with less than a high school degree and the percent with a bachelor's degree or higher. The ability to find

meaningful work in times of economic hardship are becoming increasingly dependent on an individual's level of education. This did not used to be the case when manufacturing jobs dominated communities as they did not require any specified degree, nor were they particularly competitive. This is not to suggest that obtaining a college degree or higher will make the individual immune to job-loss or drug addiction, it is simply to explain the ways in which the employment world has changed.

Less than High School Degree, 2013-2017



Bachelor's Degree or Higher, 2013-2017



Once again, the emphasis on central Appalachia can be seen most apparently in the map of bachelor's degrees or higher, but these low rates are spread throughout the entire region. The national average between 2013-2017 for less than a high school degree was 13.4% while that of bachelor's degree was 30.9. For Appalachian counties, the averages were 15.6% for less than high school and 17.5% for bachelor's degree or higher. 38% of counties were at or below the national high school rate, meaning that 158 of 420 counties had 13.4% or less of its population with only less than a high school degree. Only 5% of Appalachian counties were at or above the rate for bachelor's degree or higher, meaning 22 of 420 counties had 30.9% of more of its population with a college or graduate education. For less than high school, most of these counties are Transitional economies (90 of 158) and mostly Noncore (56 of 158). For bachelor's degree or higher, most of these counties are Transitional economies (16 of 22) and mostly Medium/Small Metro counties (11 of 22).

Based on the bachelor's degree attainment map, the data was divided into quintiles: the lowest including counties with 4.9% to 14.44% of the population with a bachelor's degree or higher, while the highest includes counties with 43.06% to 52.6% of the population with a bachelor's degree or higher. Kentucky, Tennessee, and West Virginia have the most counties in the lowest quintile of attainment with 40, 32, and 23, respectively. 100 of all of the 174 (57%) counties in the lowest quintile are considered noncore and 63 are Distressed economies.

These findings follow closely to the rural-economic trends discovered above which support the story of increased opioid usage in these areas. While these educational

statistics are not meant to prove causation for opioid use, they are another piece of the puzzle that helps to explain what factors have set up the Appalachian Region to be susceptible to the crisis. Education has become a privilege that contributes to one's ability to find and maintain meaningful job opportunities, especially during times of economic turmoil within the US markets. In the event of job loss, someone with a higher level of education is better equipped to get another well-paying job. On the other hand, someone who is less educated or without much experience might end up losing their job and being unemployed for an extended period of time. This is especially pertinent in the areas that have single industries dominating the economic sector, such as the aforementioned steel industry in Monongahela Valley, the furniture business in rural North Carolina, and the coal mining communities in central Appalachia. This was evident by the negative effects of globalization which left these residents who relied on their manufacturing-based skills with few alternatives when the changes ensued.

V. Findings and Recommendations

The opioid crisis was analyzed at several geographic levels, most thoroughly at the county level in the Appalachian Region. The six indicators explored alongside opioid use helped frame the epidemic by understanding the underlying societal factors that allowed it to impact certain parts of the country and population groups more than others. By first comparing nonmedical opioid use by region, we were able to see how North America matches up against the rest of the world. Using the United States as the country case study for this thesis, the opioid crisis was then broken down into socioeconomic, geographic, and cultural aspects, all of which included several data indicators that were

studied in-depth at the county level. It was made clear by the data visualizations that even within the Appalachian Region, there were certain areas, namely the central region which is the most rural part of Appalachia, that were underperforming in terms of unemployment rates, educational attainment, and accessibility of healthcare, all the while experiencing the highest rates of opioid use. For this reason, the efforts to tackle the crisis must include interventions that address these structural concerns.

While this paper primarily focused on the Appalachian Region, the opioid crisis has affected communities throughout the nation and has had country-wide effects, as seen in the decrease in life expectancy. For this reason, it is in the best interest of all levels of government and nonprofits or nongovernmental organizations to address this issue. The crisis happened within the borders of this country and the more that is understood about the extent of it and the factors that affect it, the easier it becomes to focus efforts to combat it. While there are many levels to the opioid epidemic and it cannot be solved by addressing one specific area nor by just one level or branch of government, the first step to minimizing the effects of the crisis is the continued increase of awareness, specifically through investments in research and data collection.

There are several gaps in the availability of data that could make the research and literature much stronger and improve the probability of locating the areas in the most need. The difficulty of reporting data in rural communities is acknowledged, but through the work of nonprofits, NGOs, or any centralized source of performing data collection, this could help find solutions to this epidemic. Additionally, it would provide a more comprehensive understanding of the ways in which different groups of people were

affected by it. Relating specifically to this thesis, the ability to gather data on racial and ethnic groups, namely Non- Hispanic Black or African Americans and Hispanic or Latinos was hindered by the unreliability and underreporting by the CDC. Data collection is getting more consistent as the years go by, however taking a longitudinal approach is more difficult when comparisons over time cannot be made. This was even an obstacle for such integral measures relating to the crisis such as overdose death rates for all races, ethnicities, and sexes. For this reason, the most recent five years of data had to be combined to produce a sufficient number of counties represented. As the data improves, so too will the research, knowledge, and explanations of possible causes of the crisis.

Going a step further beyond the need for these organizations to help in the conducting of reliable data, includes the solutions that they put in place. The best approach to solving issues impacting local communities is through empowerment and involvement of the people themselves because they are the ones experiencing the consequences, while also having the best understanding of the ins and outs of the area. These community-based approaches and initiatives ensure the best possible and lasting outcomes. Some examples include the expansion of opioid-specific treatment facilities in rural areas and chronic pain support groups, opioid education programs in schools, awareness programs for adults to help them navigate the healthcare system and explore their treatment options, and efforts to change the stigmas that discourage people who are suffering from addiction from seeking treatment. There are undoubtedly societal aspects at the county, state, or national level which are difficult to combat, such as the pain management culture. However, through multi-level approaches that take into

consideration the factors that are most pressing and able to be solved, the outlook can improve.

There have been several measures taken at various levels of government to combat the crisis, specifically President Donald Trump's 2017 declaration of a public health emergency and subsequently the creation of the Commission on Combating Drug Addiction and the Opioid Crisis led by former New Jersey Governor Chris Christie (Hoagland et al. 2019, 9). They proposed a set of recommendations mainly geared towards preventing, testing for, and treating drug use, educational and media programs to inform the public, increased accessibility to recovery opportunities, and improved research and development by federal agencies. The comprehensive and in-depth analysis of the opioid crisis conducted in the Commission's report highlighted the policy areas in need of attention and the ways in which funding and resources should be best allocated. A key inclusion in the report, which is relevant to this thesis, are the visualizations displaying the number of treatment facilities by level of urbanization broken down by those for substance use disorder, opioid-specific treatment programs, and ones that accept Medicaid. Consistent with the rural-urban divide that was explained throughout this paper, as of 2016 99% of Noncore Nonmetro counties and 91% of Micropolitan Nonmetro counties have zero substance use disorder treatment facilities with opioid treatment programs, 70% of Medium/Small Metro counties with no opioid programs in the treatment facilities, 70% for Large Fringe Metro, compared to only 12% for Large Central Metro. The discrepancy between the counties with a high concentration of opioid

use and those where the appropriate treatment facilities are located further prevent the proper action needed to combat the crisis.

Following the release of this report, President Trump then issued his plan entitled the *Initiative to Stop Opioid Abuse and Reduce Drug Supply and Demand*, which was a step in the right direction by bringing continued attention and policy-based focus towards the opioid crisis. However, it was met with much criticism. It did not include the specific numbers and details that could direct action and hold the government responsible for making changes, while it also emphasized strengthening criminal penalties, which has been an inadequate approach in the past (Gross and Gordon 2019, 70). Another criticism is the fact that there was nothing regarding pain and pain management alternatives, an aspect that Gross and Gordon (2019) address in an article which analyzes the United States' policy about pain. It argues that policies geared solely towards opioid use and not pain are not effective enough in the long run and could have adverse effects on the advancement of pain management and prolonging the opioid crisis (Gross and Gordon 2019, 71). I am in agreement with the fact that pain is not going to disappear even if the opioid crisis is solved and in order to prevent a repeat of it, the public should be aware of the alternative nonpharmacological treatments for pain. This form of treatment includes physical therapy, exercise therapy, yoga, and Eastern medicine techniques such as acupuncture. These methods should be encouraged before any pharmaceutical approach is referred to the patient.

The CDC made important strides in 2016 when it released a set of guidelines for proper opioid prescribing practices as well as recommendations for non-opioid pain

management approaches. These guidelines were aimed at primary care providers "who treat adult patients with chronic pain in outpatient settings excluding palliative and end-of-life care" (Gross and Gordon 2019, 69). The CDC explained that long-term opioid use usually begins with treatment for acute pain, therefore the instructions for prescribing opioids for patients with short-term pain are very specific and call for the lowest possible dose strength and shortest time length. The time frame for the treatment plan is 3 days, stating that more than a 7-day dosage is unnecessary for this type of pain. Additionally, it recommends prescribing immediate-release opioids as opposed to extended release/long acting opioids to treat only the necessary amount of pain that warrants opioid use and decrease the time that the patient is taking the pills. There are several other actions that should be taken on the part of primary care providers to limit the likelihood of opioid addiction in the event that they must be prescribed; the CDC emphasizes the need for patient involvement in their care plan, including the determination of realistic goals for their treatment outcome, the clear understanding of the risks they are taking on during opioid-based treatment, and the acknowledgement that "opioid therapy will be discontinued if benefits do not outweigh risks" (Dowell, Haegerich, and Chou 2016). The inclusion of the patient in the plan of action regarding their own health is critical so that the person is more aware of their symptoms and in tune with their body throughout the process. The CDC guidelines frame opioids as a last-result approach to treating pain, something that I am in favor with as I believe there are many other methods, such as those I previously mentioned, that do not put the patient in any position to develop an addiction.

The nonopioid forms of pain relief are undoubtedly less profitable for the private sector. However, the amount of lives that have been taken by the crisis and the incredible damage done to communities have proved that opioids cannot be America's solution to pain. Insurance companies need to increase their coverage of non-prescription drug alternatives and mental health services as there is a considerable amount of research that suggests the effectiveness of these treatments (Dowell, Haegerich, and Chou 2016; Gross and Gordon 2019). This poses a serious threat to people living in rural communities as their knowledge of and access to what is available outside of what is covered by their policies is limited.

As was made clear throughout this thesis, the prescribing practices of doctors are not the only driving factor for the opioid crisis as it is a multi-faceted problem. There are certainly many ways in which primary care providers can help mitigate the likelihood of abusing opioids, as there are also ways in which pharmaceutical companies must be held responsible for their role in the crisis. However, the other stakeholders, such as federal, state, and local legislators, insurance companies, private organizations, and public agencies must be actively involved in the process as well. The more that people in positions of power can be on the same page for solving the crisis, the easier it will be to do so because no one entity can solve it on their own. This includes following a standardized set of guidelines, such as those provided by the CDC, strengthening regulations of the pharmaceutical and insurance industry, the sharing and integration of data to develop a tool or dashboard that can be used by the public and private sector alike

to navigate the crisis with consistent information, and increased funding for programs whose efforts are centered on solving the crisis.

VI. Conclusion

The culmination of the opioid crisis has been the decrease in life expectancy in the United States. This epidemic has affected the United States' position on the global stage as one of the most developed countries in the world since it was unable to prevent it from becoming so destructive. I acknowledge that there were several driving factors beyond the reach or control of the government, however the country did not uphold its responsibility of protecting its citizens from the dangers of these drugs and minimizing the effects of the crisis. This retrospective approach of reflecting on the projection of the crisis can help to pinpoint what can be done better in the event that something similar happens again here or in another country, but also through analyzing the driving factors, the country can be more informed on what went wrong.

While the United States is not the only country that has been affected by the crisis, nor is the Appalachian Region the only region of the country that has suffered, they both are used as case studies to more clearly determine the drivers of the crisis. Through the use of data visualizations, statistics, and state and county level case studies, the ways in which the opioid crisis has been exacerbated throughout the United States, specifically in the Appalachian Region can be understood. The comparisons made throughout this thesis between the different indicators and against the opioid overdose rates emphasized the interconnectivity of the variables. The literature on the topic laid the foundation for the driving factors, however by explaining and visualizing the ways in

which each individual factor has affected opioid use, several contributions were made to the discussion of the crisis. The comprehensive approach, which included geographic, socioeconomic, and cultural driving factors provided a complete picture of what has helped put the United States so far ahead of other countries in terms of opioid use and overdose deaths and how the Appalachian Region in particular came to suffer in the manner that it did.

The move towards integrating data visualizations into research reports is very beneficial in the ability to reach a wide range of people from different educational and occupational backgrounds. When readers can interact with the data through maps, graphs, and charts rather than strictly numbers on a paper or narratives, they are more likely to respond and relate to the issue. They can input their own knowledge and expertise and draw conclusions from the data, relating the information to their own line of work. It is much more approachable for everyone and it is not of importance whether or not they are familiar with the details of data science and data visualization. The complex and multi-layered aspect of the opioid crisis was broken down by the visuals and the accompanying explanations, a method that should continue to become commonplace in all areas of research.

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