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Understanding the Changing Hepatitis B and Hepatitis C Epidemics

By

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Doctor of Philosophy

Epidemiology

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Understanding the Changing Hepatitis B and Hepatitis C Epidemics

By

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MPH, Emory University, 2015
BS, University of Michigan, 2010

Advisor: Patrick S. Sullivan, DVM, PhD

An abstract of
A dissertation submitted to the Faculty of the
James T. Laney School of Graduate Studies of Emory University
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Abstract

Understanding the Changing Hepatitis B and Hepatitis C Epidemics
By Eric W. Hall

In the United States, over 3 million people are currently infected with hepatitis B virus (HBV) or hepatitis C virus (HCV), two major causes of liver disease, liver cancer and liver-related death. After decades of substantially decreasing disease incidence, new cases of HBV and HCV are on the rise in the United States, partially because of increased transmission among persons who inject drugs. Despite these recent trends, advancements in prevention and treatment interventions have the public health community strategizing to eliminate viral hepatitis transmission.

In the first study, we modeled county-level HCV death rates and estimated HCV mortality trends. Although many health jurisdictions have experienced declines in HCV mortality since 2013, the magnitude and composition of those declines has differed by place. These data provide a better understanding of geographic differences in HCV mortality and can be used by local jurisdictions to evaluate HCV mortality in their areas.

In the second study, we developed a novel longitudinal metric that summarizes the relationship between opioid prescribing practices and drug overdose mortality, and then assessed trends in this metric by characteristics of place. Opioid prescribing practices and drug overdose mortality both continue to be ongoing public health challenges, but how they interact differs by geography and place. This novel summary metric provides an additional data point that can used in future research to enhance our understanding of the shift in overdose mortality away from prescription opioids to other drugs.

In the third study, we conducted an economic evaluation of a universal hepatitis B vaccination recommendation for all U.S. adults. We found that a universal adult HBV vaccination strategy may be appropriate for reducing new HBV infection and improving health outcomes, particularly in scenarios that result in high vaccination coverage among high-risk adults. These results can be used by vaccine policy makers to reevaluate HBV vaccination guidance.

Our findings result in new data that improve our understanding of current viral hepatitis epidemics and potential interventions. We provide granular data relevant to local health department prevention planning, a new opioid metric, data relevant to national policy makers and an informative framework for future research.

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Chapter 1: Background and Significance

Natural History

Viral hepatitis is inflammation of the liver that is caused by infection with one of five different viruses (hepatitis A, hepatitis B, hepatitis C, hepatitis D and hepatitis E). The two most common causes of viral hepatitis are hepatitis C virus (HCV) and hepatitis B virus (HBV).[1] Although some infections may spontaneously resolve, infection with either HCV or HBV can cause chronic disease that leads to additional health complications. In the United States, state and local health departments report new cases of hepatitis A, hepatitis B and hepatitis C to the Centers for Disease Control and Prevention (CDC) through the National Notifiable Diseases Surveillance System (NNDSS) on a weekly basis.[2]

Acute and Chronic HCV Infection

An acute HCV infection is defined by the presence of clinical symptoms consistent with viral hepatitis (e.g. fever, headache, malaise, anorexia, nausea, vomiting, diarrhea, abdominal pain, jaundice, and elevated serum alanine aminotransferase levels), a positive test for antibodies to HCV (anti-HCV), and a positive HCV virus detection test (e.g. HCV RNA positive or HCV antigen positive).[2] A positive anti-HCV test and a negative HCV RNA test indicate a person had previously been infected with HCV and cleared the infection or was successfully treated for the infection. An infection becomes chronic when it remains active (anti-HCV+ and HCV RNA+) for at least six months.[2] In adults, HCV is very likely to develop into a chronic health problem, with 75-85% of acute infections progressing to a chronic infection.[3-5] If untreated, chronic HCV infections can remain asymptomatic for decades before eventually progressing to end-stage liver disease (ESLD) or hepatocellular carcinoma (HCC), and eventually death. Prognosis is often difficult to determine because disease progression is influenced by a variety of individual factors such as age at infection, sex, alcohol consumption, obesity, type 2 diabetes, co-infection with HBV or HIV, and genetic factors.[5] Overall, about 10-20% of HCV-infected individuals who are not treated will develop cirrhosis within 30 years. Once an HCV-infected person develops cirrhosis, there is a 1-5% annual risk of liver cancer (hepatocellular carcinoma) and a 3-6% annual risk of hepatic decompensation, both of which have increased death rates.[5] In general, without treatment, age-adjusted mortality for liver disease is 12 times higher in persons with chronic HCV infection compared to the general population.[6]

Acute and Chronic HBV Infection

An acute HBV infection is defined by the presence of the same viral hepatitis clinical symptoms described above with a positive hepatitis B surface antigen (HBsAg) test. An infection becomes defined as chronic with the presence of a second positive HBsAg test, a positive hepatitis B e antigen (HBeAg) or a positive HBV DNA at least six months after the initial test.[2] The risk of an acute HBV infection progressing to a chronic HBV infection differs dramatically by age. Without intervention, about 90% of infected infants will develop a chronic infection, while less than 5% of infected adults will progress to a chronic infection.[7-9] Individuals with a chronic HBV infection can progress, in a non-linear fashion, through several disease phases defined by the presence or absence of HBeAg, levels of HBV DNA and immune system activity.[10] Although the various stages of disease have implications for treatment, infectivity, and disease progression, any person with a chronic infection can develop additional health complications such as liver cancer (HCC), liver failure and decompensated cirrhosis.[10] About 25% of chronic infections that occur during childhood and 15% of chronic infections that occur in adults will lead to premature death from cirrhosis or liver cancer.[8,11]

Transmission

HCV is primarily transmitted through percutaneous exposure to contaminated blood. Although transmission can also occur through mucous membrane exposure to contaminated blood, that mode of transmission is less efficient than blood exposure. HCV is detectable in other body fluids such as saliva, semen and breastmilk, but those fluids are not believed to contribute to transmission.[12,13] HCV can persist on surfaces (such as drug injection equipment) and remain infectious for up to six weeks.[14,15] In the United States, injection drug use is the most common risk factor for HCV[1], but HCV can also be transmitted through blood transfusions with infected blood, birth to an infected mother, accidental needle sticks and sex with an HCV-infected person. Receipt of blood transfusions or organs from infected persons was a common means of HCV transmission in the United States prior to 1990, but standard blood product testing and infection control practices have greatly reduced that type of transmission.[5] Perinatal transmission occurs in about 5% of infants born to mothers infected with HCV and almost always occurs when mothers have detectable HCV RNA in their blood.[16]

Although HBV can be transmitted through exposure to infected blood or body fluids, the highest concentrations of virus are found in blood. HBV can survive on an external surface for seven days and transmission can occur even if infected blood is not visible.[13,17] Any person who is HBsAg-positive can transmit the virus, but people with elevated levels of HBV DNA or HBeAg protein are most infectious. Among adults, HBV is most commonly transmitted by a skin puncture with an exposure to infectious blood (e.g. injection drug use) or sexual contact. Injection drug use and having multiple sex partners are the most common risk factors for HBV transmission.[1]

Epidemiology

HCV Morbidity and Mortality

State and local health departments are required to submit case reports on new acute HCV infections through CDC's National Notifiable Diseases Surveillance System (NNDSS). However, the burden of HCV is not well understood or described because most new infections go unreported due to etiological reasons (e.g. many cases are asymptomatic), differences in state lab testing requirements, inconsistent application of case definitions and a lack of surveillance resources.[18] In 2017, 3,216 new cases of acute HCV were reported from 43 states.[1] However, the actual number of new infections is estimated to be 13.9 times the number of reported cases[19] -- an estimated 50,300 new acute HCV cases in 2018[20].

Data from large, complex, nationally representative cross-sectional surveys (i.e. National Health and Nutrition Examination Survey[21], NHANES) have been used to estimate that there were 4.1 million (1.7% of the population) anti-HCV positive adults (indicating previous or current infection) and 2.4 million (1.0% of the population) HCV-RNA-positive (indicating chronic HCV infection) adults in 2013-2016.[22-24] Small-area estimation statistical models have incorporated these data to estimate state level HCV prevalence and found 9 states (California, Texas, Florida, New York, Pennsylvania, Ohio, Michigan, Tennessee and North Carolina) contained more than half of all persons living with HCV in the U.S. from 2013-2016.[25-27] Extensions of the same models estimated chronic HCV prevalence to be higher among males and non-Hispanic blacks, with the magnitude of the racial disparity differing by state.[28] Historically, HCV prevalence has been disproportionately high in persons born between 1945 and 1965: roughly three quarters of HCV infections occur in a group that makes up about one quarter of the U.S. population.[29] Most of these individuals likely acquired their infection years ago, possibly through the reuse of medical equipment.[30] However, all of these are model-based period prevalence estimates anchored to data from NHANES, which has limitations when used for surveillance purposes. NHANES data are not collected frequently enough to monitor changes in prevalence, and there is debate about the ability to accurately account for disease burden in critical high-risk populations for HCV infection not sampled by NHANES (e.g. incarcerated and institutionalized persons).[31,32]

Each year, just under 20,000 death certificates include HCV as a cause of death and, in 2013, annual mortality associated with HCV infection surpassed mortality from 60 other nationally notifiable infectious diseases (including HIV) combined.[33] However, because of challenges similar to those that occur in the surveillance of new HCV cases, prevalent infection with HCV is not always captured on death certificates and the actual total of HCV-related deaths is likely much higher. Data from a multisite cohort study found only 19% of persons with a chronic HCV infection ended up having HCV listed on their death certificate.[6]

HBV Morbidity and Mortality

Many of the same challenges that exist in capturing new HCV cases also apply to the ascertainment of new HBV infections. In 2017, a total of 3,409 cases of acute hepatitis B were reported to CDC[1], but the true number of new infections is estimated to be 6.5 times higher than that[19], resulting in an estimated 22,200 new HBV cases. Many infections go unreported because most infected individuals are asymptomatic, only some people with symptoms actually seek care and receive a diagnosis, and some states never report their data to CDC.[1,19,34]

Using data from NHANES, CDC estimated there were 850,000 people (0.3% of total U.S. population) living with a chronic HBV infection in the United States in 2012.[35] Additional analyses found prevalence to be higher among Asians (2.7%) compared to other races/ethnicities.[36] However, these national estimates may undercount the true burden of HBV because the NHANES sampling frame does not include institutionalized, homeless or incarcerated persons, which comprise people that typically have higher HBV prevalence[37] than the general population. A separate study based on the prevalence of HBV by countries of origin for people migrating to the United States estimated there are 2.2 million chronic HBV infections in the U.S.[38] Foreign-born persons have a higher prevalence of chronic HBV (3.5%)[38] and now account for 95% of newly reported chronic HBV infections.[39]

The most recent national analysis of hepatitis B on death certificate data found hepatitis B had an age-adjusted national mortality rate of 0.56 deaths per 100,000 person-years in 2007.[40] Annually, about 1,800 death certificates list HBV as a contributing cause of death.[1] Similar to HCV, only a fraction of hepatitis B-related deaths actually have HBV listed as a contributing cause on the death certificate. An analysis of a cohort of patients with a known chronic HBV infection found that only 19% of all deceased patients had HBV listed on their death certificate.[41]

Prevention and Treatment

HCV Screening and Treatment

Although there is not currently a vaccine for hepatitis C, testing and screening strategies have previously had success in reducing HCV transmission and mortality. In 1990, serologic tests to detect HCV antibodies were licensed and blood banks began screening blood donations. In 1991, the U.S. Public Health Service first issued guidelines that recommended the testing of all donors of blood, organs, tissues or semen for HCV, and in 1998, those guidelines were expanded to recommend testing persons with known risk factors for HCV.[42] Considering about 45% of persons infected with HCV do not report having any risk factors[34], CDC further amended screening guidelines to recommend testing of any persons born between 1945 and 1965.[29]

Finally, in 2020, CDC expanded HCV screening guidelines to recommend once in a lifetime testing for all adults 18 years of age or older and HCV screening for all pregnant women at each pregnancy.[43]

In addition to potential prevention benefits, emphasis on the identification of existing HCV infections has increased because of an evolution in treatment options. Direct-acting antiviral medications (DAAs) with cure rates over 90% became available in 2014.[44,45] Due to low levels of toxicity and regimen simplicity, DAAs have largely replaced prior treatments that are less effective and more toxic.[46] Treatment with DAAs involves an oral regimen taken daily for 8 to 12 weeks.[47] In addition to resolving a current chronic infection, there is evidence that treatment may limit HCV transmission[48] and can have a significant impact of the current trajectory of the HCV epidemic.[49] Despite the evident benefits of treating HCV infection with DAAs, access to treatment has been limited by inadequate disease identification, high drug costs, eligibility criteria, political disinterest and lack of specialty providers in several areas around the country.[50,51]

HBV Screening and Vaccination

A safe and effective vaccine (HepB) to prevent HBV acquisition was first introduced in 1981. Three doses of HepB vaccination provide protection to over 95% of healthy infants[52] and >90% of healthy adults.[53] In 1991, the U.S. adopted a strategy for universal vaccination of all infants as part of a comprehensive strategy to eliminate HBV transmission.[54] The strategy has evolved to include routine testing of all pregnant women for HBsAg, universal vaccination of infants at birth, routine vaccination of previously unvaccinated children and vaccination of adults deemed at high risk for HBV infection[8,9,55-58] (Figure 1).

Figure 1. Adults recommended for vaccination against HBV infection (ACIP)

1. Persons at risk for infection by sexual exposure
    a. Sex partners of hepatitis B surface antigen (HBsAg)–positive persons
    b. Sexually active persons who are not in a long-term, mutually monogamous relationship (e.g., persons with more than one sex partner during the previous 6 months)
    c. Persons seeking evaluation or treatment for a sexually transmitted infection
    d. Men who have sex with men
    e. Persons at risk for infection by percutaneous or mucosal exposure to blood
2. Current or recent injection-drug users
3. Household contacts of HBsAg-positive persons
4. Residents and staff of facilities for developmentally disabled persons
5. Health care and public safety personnel with reasonably anticipated risk for exposure to blood or blood-contaminated body fluids
6. Hemodialysis patients and predialysis, peritoneal dialysis, and home dialysis patients
7. Persons with diabetes aged 19–59 years; persons with diabetes aged ≥60 years at the discretion of the treating clinician
8. International travelers to countries with high or intermediate levels of endemic hepatitis B virus (HBV) infection (HBsAg prevalence of ≥2%)
9. Persons with hepatitis C virus infection
10. Persons with chronic liver disease (including, but not limited to, persons with cirrhosis, fatty liver disease, alcoholic liver disease, autoimmune hepatitis, and an alanine aminotransferase [ALT] or aspartate aminotransferase [AST] level greater than twice the upper limit of normal)
11. Persons with HIV infection
12. Incarcerated persons
13. All other persons seeking protection from HBV infection

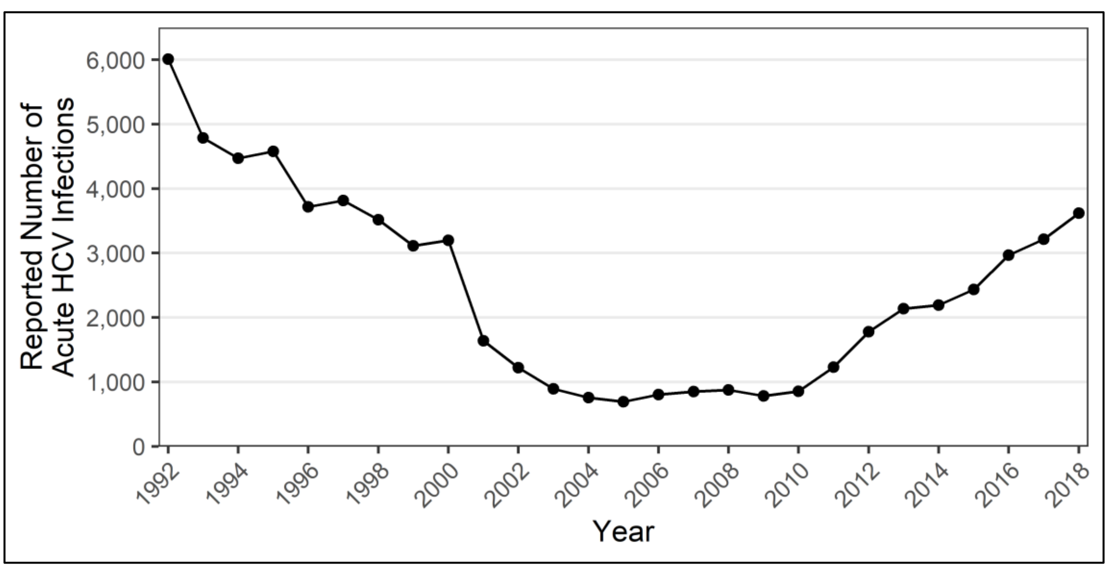
Since the recommendation to universally vaccinate infants in 1991, coverage has been relatively high among children -- 71% of infants receive 1 dose of vaccine within 3 days of life[59] and 90.5% of children aged 19-35 months receive at least 3 doses of vaccine.[59] Data from a large, reccurring telephone survey of parents and providers indicate 91.9% of adolescents aged 13-17 years have received at least 3 doses of vaccine.[60] Despite increases in vaccination uptake among children born after 1991, vaccination coverage is much lower in adults, including in the high risk groups recommended for vaccination.[9] In 2016, less than 25% of adults over 29 years of age reported being vaccinated against HBV.[61]

After chronic infection occurs, there is not a curative treatment for HBV infection. However, there are guidelines for management and treatment of chronic infections[10,62] that can lead to slower disease progression and reduced mortality. Screening strategies aim to detect the virus before it causes liver damage so that care can be initiated. Current HBV screening guidelines recommend screening persons who were born in countries with intermediate or high endemic hepatitis B or report risk factors, such as injection drug use.[63,64]

Recent Trends in Incidence

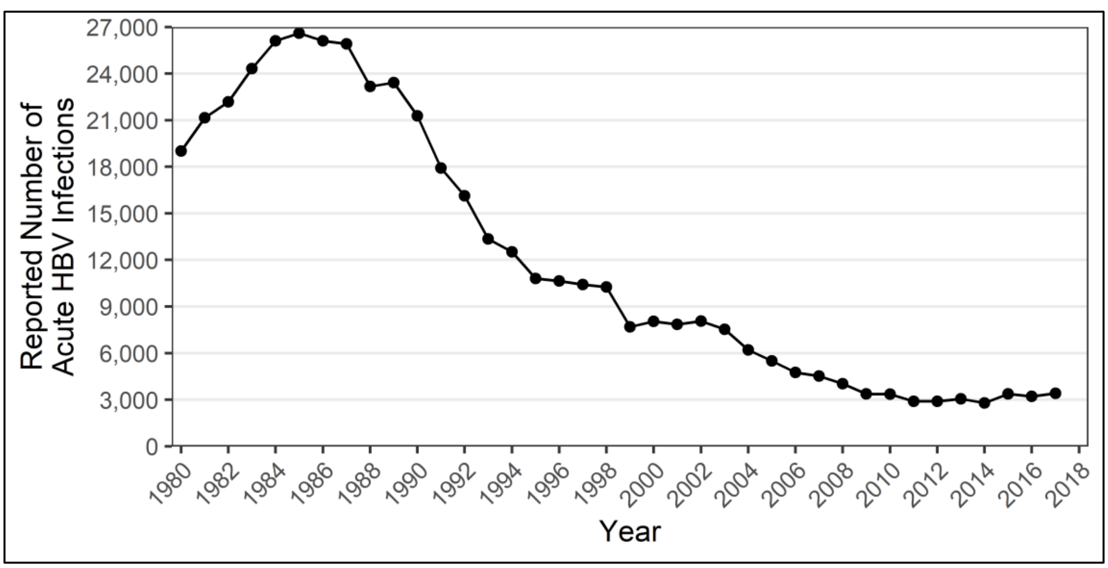
Historically, annual incidence for both HCV and HBV have experienced a noteworthy decline since the early 1990s. After initiating and improving blood screening practices among blood and organ donors, reported HCV incidence rapidly declined between 1992 and 2002 (Figure 2). Despite relatively flat trends from 2002 to 2010, the estimated number of new acute HCV infections more than tripled between 2010 and 2018 (Figure 2)[20]. The largest increase in HCV incidence occurred among adults aged 20-39 and among white persons that live in non-urban counties.[65]

Figure 2. Number of acute HCV cases reported to CDC by year, United States, 1992-2018



A comprehensive national strategy to eliminate HBV through vaccination was introduced in 1991[54], and as a result, acute HBV incidence decreased 81% between 1990 and 2006.[66] However, since 2012, there has not been a consistent trend and the number of acute HBV infections reported to CDC has fluctuated around 3,000 cases per year[1] (Figure 3). Considering high vaccination levels in children result in a higher proportion of the population having vaccine-induced protection each year, this stalling or reversing of previous declines in HBV incidence is particularly concerning. Since the introduction of infant vaccination for HBV, HBV incidence rates have been lowest among children and adolescents. Since 2015, HBV incidence has declined among adults aged 20-29 years as persons in this group become the first age cohort who were vaccinated as children to reach young adulthood. However, these decreases have been balanced by increasing HBV incidence among adults 40+ years of age, which has led to the overall HBV incidence rate remaining stable, albeit at a level 85% lower than incidence rates two decades ago.[1]

Figure 3. Number of acute HBV cases reported to CDC by year, United States, 1982-2017



There is now a substantial amount of evidence indicating recent trends in HCV and HBV incidence are being driven by an increase in injection drug use (IDU) as a result of the opioid epidemic.[67,68] Large increases in prescription opioid use and abuse[69] have led to large increases in injection drug use as people transition from oral opioid use to injection use of opioids.[67,68,70,71] In recent years, health department investigations have uncovered several outbreaks of HCV, HBV, and other infectious diseases such as HIV, among injection drug users, many of which are associated with prior abuse of prescription opioids.[72-78]

In 2017, injection-drug use was reported in 72.6% of new HCV and 37.1% of new HBV infections that included data on drug use.[1] Increases in injection drug use, and resulting infectious disease incidence, disproportionately affect young people who live in rural areas east of the Mississippi River (particularly in central Appalachia). In 2017, the states with the highest acute HCV incidence rates were West Virginia, Massachusetts, Indiana, Utah and Tennessee.[1] Similarly, HBV incidence rates were highest in West Virginia, Maine, Kentucky, Tennessee and Florida.[1] In Kentucky, Tennessee and West Virginia, the proportion of HBV cases that reported injection drug use rose from 53% from 2006-2009 to 75% from 2010-2013.[79] In those same states (plus Virginia), the proportion of substance use treatment admissions that reported injection as their main method of drug administration increased from 2006-2012.[80] The same demographic groups (young, non-Hispanic white, Hispanic) that have experienced the largest increases in HCV/HBV incidence have also experienced increases in admissions to substance use disorder treatment programs for opioid abuse.[81]

Public Health Priority: Elimination of HCV and HBV

The availability of curative treatment for HCV and an efficacious vaccine for HBV has led a variety of institutions and multiple levels of government to develop and implement strategies to eliminate viral hepatitis. In 2016, the World Health Organization (WHO) released a global strategy to eliminate viral hepatitis as a public health threat by 2030.[82] Guided by the

WHO targets, the U.S. National Academies of Sciences, Engineering, and Medicine (NASEM) released a two-part report that assessed the feasibility of HCV and HBV elimination in the U.S. and identified current obstacles.[83,84] The U.S. Department of Health and Human Services (HHS) established a National Viral Hepatitis Action Plan that outlines prevention priorities for the nation.[85] Within that context, CDC has developed a Viral Hepatitis Strategic Plan[86] that identifies specific, high impact prevention activities and will be monitored with annual progress reports.[87] Subsequently, several state health departments have begun to develop and initiate their own local strategic plans for curbing the viral hepatitis epidemics.

Existing Barriers to Elimination

The 2017 NASEM report concluded that both HBV and HCV could feasibly be eliminated in the U.S. if elimination efforts were prioritized.[84] However, there are currently a variety of health system and social barriers to achieving elimination. First, basic understanding of the epidemiologic nature of the viral hepatitis burden is lacking, primarily because of insufficient disease surveillance. Viral hepatitis surveillance is inconsistent and underfunded, which results in incomplete data and a limited understanding of how the HCV and HBV epidemics are impacting different communities.[18,84,88] Although CDC does provide funding for a handful of states to conduct enhanced viral hepatitis surveillance[89], most other states do not have dedicated resources to conduct full surveillance programs. The case definitions for acute HBV and acute HCV require knowledge of clinical symptoms, and the case definitions for chronic infections require analysis of biomarkers at different points in time.[2] As a result, health departments must have the ability to sufficiently align clinic and lab data for individuals over time to properly classify possible cases of HBV or HCV. Additionally, there is concern that patients who are diagnosed based on clinical indications may not meet the definition for inclusion in national statistics, resulting in underestimates of burden.[90] Accurate knowledge of the true burden of disease and the number of people at each stage of the care continuum is essential for allocating interventions and tracking progress towards elimination of both HBV and HCV.

In addition to reporting and monitoring new infections, identifying individuals already living with prevalent HCV or HBV infections is an essential step in improving their prognosis and preventing future transmission, but there are large gaps in current knowledge of infection. Nationally, only 55.6% of people with chronic HCV and 33.9% of people with chronic HBV are aware of their infection.[34] Given the lack of knowledge of infection and large estimated burden, HCV in particular has been called the "Silent Epidemic". One major barrier to infection identification is that viral hepatitis infections can remain asymptomatic for decades and individuals may never seek care. Additionally, most new HCV and HBV infections occur because of injection drug use and drug users are less likely to be in the healthcare system. Although screening guidelines for groups of people specific to each virus have been in place for years[29,43,91] (e.g. persons born during 1945-1965 for HCV; pregnant women and persons born in countries where HBV is endemic for HBV), screening is still not a widespread practice. One cohort study in Boston found that only 36 percent of foreign-born patients were screened for HBV infection.[92]

Beyond the identification of new and prevalent infections, there are challenges in linking infected individuals to treatment and retaining them in care. Although curative treatment for HCV is now available, access to treatment remains low. Prior to the release of DAAs in 2014, only about a third of chronically infected persons that were aware of their infection were on treatment.[93] An analysis of revenue data from drug companies estimated that only 7-14% of people with HCV infection have initiated treatment with DAAs.[84] Similarly, of the 850,000-2.2 million HBV cases in the U.S., it is estimated that only 50,000 are receiving treatment.[94] High cost of treatment and difficulty in reaching chronically infected persons contributes to low treatment rates for both HCV and HBV. Additionally, HCV and HBV disproportionally affect marginalized groups of people (e.g. injection drug users, foreign immigrants, people in correctional facilities) and a social stigma around viral hepatitis infections often impacts an individual's mental health and his or her willingness to participate in care.[84]

A noteworthy barrier specific to HBV elimination efforts is a lack of ability to track vaccination status among adults.[84] Although immunization registries can, in theory, be used to identify unvaccinated adults, fewer than 40% of providers actually submit vaccination data to registries.[84] Given that vaccine coverage is low among adults, any opportunity to vaccinate an adult at risk of HBV infection needs to be acted on. The development of additional strategies or recommendations to improve vaccination coverage among adults has been identified as a priority that could have a large impact on the HBV epidemic.

Research Opportunities

Because the primary barriers to achieving the elimination of HCV and HBV have been identified and well-described, there is an opportunity to conduct research that can have a significant impact in aiding efforts to address the viral hepatitis epidemic in the United States. The priorities put forward in existing viral hepatitis elimination strategies provide researchers a framework in which to design studies that specifically address the needs of the public health community implementing these plans. This project was developed within that context and was specifically designed to address previously stated needs in the field.

Specific Dissertation Aims

In this dissertation, I addressed three specific needs that have been identified by existing strategies to curb the current viral hepatitis epidemics. First, the work from this project resulted in data that contributes to a better understanding of the burden of HCV and can be used to track progress in combating the epidemic. Second, this dissertation generated results that can help inform where HCV treatment and prevention services should be allocated or targeted. Finally, I evaluated a specific intervention that could be utilized to reduce HBV transmission on a population level. Specifically, this dissertation will achieve the following three aims:

1) Estimate small-area death rates and mortality trends for HCV-related deaths in the United States.
2) Develop a county-level measure that summarizes the relationship between prescription opioid rates and overdose deaths.
3) Evaluate the cost-effectiveness of universal HBV vaccination among all adults.

Structure of Dissertation

In Chapters 2, 3 and 4, each research aim is presented in the format of an original scientific manuscript to be submitted for publication in a journal. Finally, Chapter 5 distills the results and conclusions of all three aims into a chapter that describes innovation of this project, the significance of these findings, future directions, and public health relevance. The appendices include supplemental material that is referenced throughout the dissertation.

Chapter 2: County-Level Variation in Hepatitis C Virus Mortality and Trends in the United States, 2005-2017

Abstract

Background: In 2013, the annual number of deaths attributable to hepatitis C virus (HCV) in the United States surpassed the number of deaths from all other infectious diseases combined. However, since 2013, the national HCV death rate has steadily declined, but this decline has not been quantified or described on a local level. We estimated county-level HCV death rates and assessed trends in HCV mortality from 2005 to 2013 and 2013 to 2017.

Methods: We used mortality data from National Vital Statistics Systems and a Bayesian multivariate space-time conditional autoregressive model to estimate age-standardized HCV death rates from 2005 through 2017 for 3115 U.S. counties. Additionally, we estimated county-level age-standardized rates for persons <40 and 40+ years of age. We used log-linear regression models to estimate average annual percent change in HCV mortality during periods of interest and compared county-level trends to national trends.

Results: Nationally, the age-adjusted HCV death rate peaked in 2013 at 5.20 HCV deaths per 100,000 (95% CI: 5.12, 5.26) before decreasing to 4.34 per 100,000 persons (95% CI: 4.28, 4.41) in 2017 (average annual percent change -4.69, 95%CI: -5.01, -4.33). County-level rates revealed heterogeneity in HCV mortality (2017 median rate=3.66, interdecile range: 2.19, 6.77), with the highest rates concentrated in the West, Southwest, Appalachia and northern Florida. Between 2013 and 2017, HCV mortality decreased in 80.0% (n=2274) of all U.S. counties, with 25.8% (n=803) of all counties experiencing a decrease larger than the national decline.

Conclusions: Although many counties have experienced a shift in HCV mortality trends since 2013, the magnitude and composition of that shift have varied by place. These data provide a better understanding of geographic differences in HCV mortality and can be used by local jurisdictions to evaluate HCV mortality in their areas relative to surrounding areas and the nation. To continue the national decline in HCV mortality, increased access to prevention services, testing and care for persons living with HCV infection will be needed, particularly in counties in which HCV death rates continue to remain high.

Publication

To be submitted to TBD.

Introduction

In the United States, infection with hepatitis C virus (HCV) is the leading cause of morbidity and mortality from liver disease and was a contributing cause of death in over 15,000 deaths in 2018.[95] From 1999 to 2013, the national HCV death rate increased each year[40] and by 2013, the annual number of deaths attributable to HCV infection outnumbered deaths from all other notifiable infectious diseases combined.[33] Although data from the National Vital Statistics System indicate the national HCV death rate has declined since 2013[96], there has not been a trend analysis that quantifies change in HCV mortality since 2013.

In recent years, there have been shifts in the epidemiological nature of the HCV epidemic, advancement in treatment options, and changes in public health strategies, all of which are likely to impact HCV mortality. Although HCV infections are still disproportionately concentrated among adults born between 1945 and 1965[29], rising acute HCV incidence rates among adults <40 years of age[20] have led to emergence of a bimodal epidemic by age group. Despite the substantial prevalent burden and recent rise in HCV incidence rates, the availability of accurate diagnostic testing and curative therapy has the public health community targeting the elimination of HCV infection as a public health problem in the United States.[83,84] In the United States, strategic plans by Centers for Disease Control and Prevention (CDC)[86] and the Department of Health and Human Services (HHS)[85] have specifically identified reductions in the national HCV death rate as an indicator to monitor progress toward achieving these goals. For example, CDC's Viral Hepatitis National Progress Report 2020 Goal was to reduce the national age-adjusted HCV death rate below 4.17 per 100,000 persons[96] by 2020.

Although there is evidence the epidemiology of hepatitis C differs by location, small-area spatial differences in HCV mortality are not well described[97]. Of the estimated 2.4 million adults who were living with a chronic hepatitis C virus (HCV) infection during 2013-2016[22], over half lived in just nine states.[27] Analysis of newly reported acute and chronic HCV cases from surveillance data has shown dramatic regional differences in HCV incidence trends.[80] To our knowledge, HCV-related death rates and mortality trends have not been systematically characterized on a sub-national level. Previous research on small-area stroke[98] and heart disease[99,100] mortality has demonstrated that merely describing changes in national death rates may conceal important trends occurring at the local level. Furthermore, many public health initiatives are implemented at the county or local level, and describing geographic disparities in HCV mortality can help inform the utilization of available interventions.

This analysis had two primary objectives. First, we aimed to estimate annual county-level HCV death rates between 2005 and 2017. Second, to better understand local changes in HCV mortality, we assessed county-level trends from 2005 to 2013 and 2013 to 2017.

Methods

Data Source

Data are from the National Vital Statistics System Detailed Multiple Cause of Death micro-data files.[101] All data can be obtained by submitting a research request through the National Association for Public Health Statistics and Information Systems.[102] Using codes from the International Classification of Disease Tenth Revision (ICD-10)[103], we identified the annual number of deaths that listed HCV (ICD-10 codes B17.1 and B18.2) as a contributing cause of death for each county and demographic group of interest during 2000 to 2017. Annual county-level deaths were tabulated for all 36 combinations of the following demographic groups: race (black, white, other), sex (male, female) and age (0-19 years, 20-29 years, 30-39 years, 40-49 years, 50-59 years and 60+ years)[1]. We used National Center for Health Statistics bridged-race annual county-level population estimates[104] for population denominators in all death rates. To ensure counties were comparable across the years included in the analysis, we defined a common set of 3115 counties for all years. Institutional review board approval was not required because this analysis only used publicly available county-level data.

Estimating Death Rates and Percent Change

We used a Bayesian multivariate space-time conditional autoregressive model to model the annual number of HCV deaths for each group in each county. The details of this model, which has primarily been used to estimate stroke[98] and heart disease death rates[99,105], have been previously described.[106] Briefly, it is a conditional autoregressive model for spatially referenced count data that incorporates correlations across space, time and demographic groups. The model borrows strength from adjacent groups by iteratively estimating parameters and shrinking the random effects for each county toward values for neighboring counties and years, resulting in precise and reliable rate estimates, even in groups with a small number of deaths.[107] Each model was fit with a Markov chain Monte Carlo (MCMC) algorithm using user-developed code in R v3.5.0.

We aggregated the modeled counts to estimate overall and age-stratified (<40 years and 40+ years) county-level HCV death rates for the years 2005 through 2017. While we incorporated data from 2000 to 2017, we limited results to years after 2005 because HCV infections are disproportionately concentrated among persons born in 1945-1965[29], and all persons in this high burden cohort were 40+ years of age from 2005 onward. We estimated county-level rates using the medians of the posterior MCMC distributions and the 2.5th and 97.5th percentiles were used to calculate 95% credible intervals (95% CI). Additionally, county-level counts were aggregated to estimate national HCV death rates for each year. To facilitate comparison across place and time, all estimated rates were standardized to the age distribution of the 2000 U.S. standard population.[108]

To calculate trends, we included the estimated county rates for all years of interest in separate log-linear regression models for each MCMC iteration and each county. Average annual percent change was estimated as the median trend of all MCMC iterations within each county and the corresponding 95% CI was calculated using the 2.5th and 97.5th percentile values. National data has shown that HCV death rates across the country were increasing prior to 2013 and have declined each year since.[96] Therefore, we estimated national and county-level HCV mortality trends for 2005-2013 and 2013-2017. Furthermore, we compared county-level trends from 2013-2017 to the estimated national decline during that time period and categorized counties into the following four groups: decrease faster than national (i.e. average annual percent change is below the lower bound of the national 95% CI), decrease similar to national (i.e. average annual percent change is within 95% CI of national decline), decrease slower than national (i.e. average annual percent change is between the upper bound of national decline and zero) and increase (i.e. average annual percent change is greater than zero). By using the posterior distributions to calculate percent change and to compare against the national average, these calculations account for the uncertainty in the underlying rates.

To assess spatiotemporal trends in HCV mortality, we mapped overall and age-stratified (<40 years and 40+ years) 2017 HCV death rates by quintiles. Additionally, we mapped overall county-level average annual percent change in HCV death rates from 2005-2013 and 2013-2017 and HCV mortality trends relative to the national decline from 2013-2017.

Data Suppression

Any county-level rates that had a CI width larger than the point estimate were considered unreliable.[109] If a county had one or more unreliable HCV death rate between 2005 and 2017, estimated rates and trends for that county were not reported. Additionally, if a county had one or more unreliable rate for either age group in 2017, all age-stratified rates were suppressed for that county. These criteria resulted in reliable rates for a common set of counties for all years of overall rates (n=2839, 91.1% of all counties) and a common set of counties for all age-stratified 2017 rates (n=2570, 82.5%).

Results

In 2017, the national age-adjusted HCV death rate was 4.34 per 100,000 persons (95% CI: 4.28, 4.41, Table 1). From 2005 and 2017, the overall national HCV death rate was highest in 2013 at 5.20 HCV deaths per 100,000 (95% CI: 5.12, 5.26). On average, national HCV mortality increased by 3.17% each year (95% CI: 3.00, 3.34) from 2005 to 2013 before decreasing 4.69% each year (4.33, 5.01) from 2013 to 2017. For all years, the HCV death rate was much higher among adults 40+ years of age (9.77 per 100,000 in 2017; 95% CI: 9.65, 9.94) compared to persons <40 years of age (0.23 per 100,000, 95%CI: 0.22, 0.24).

Table 1. Estimated Age-Standardized National and County-Level Hepatitis C Death Rates and Percent Change, United States, 2005–2017.

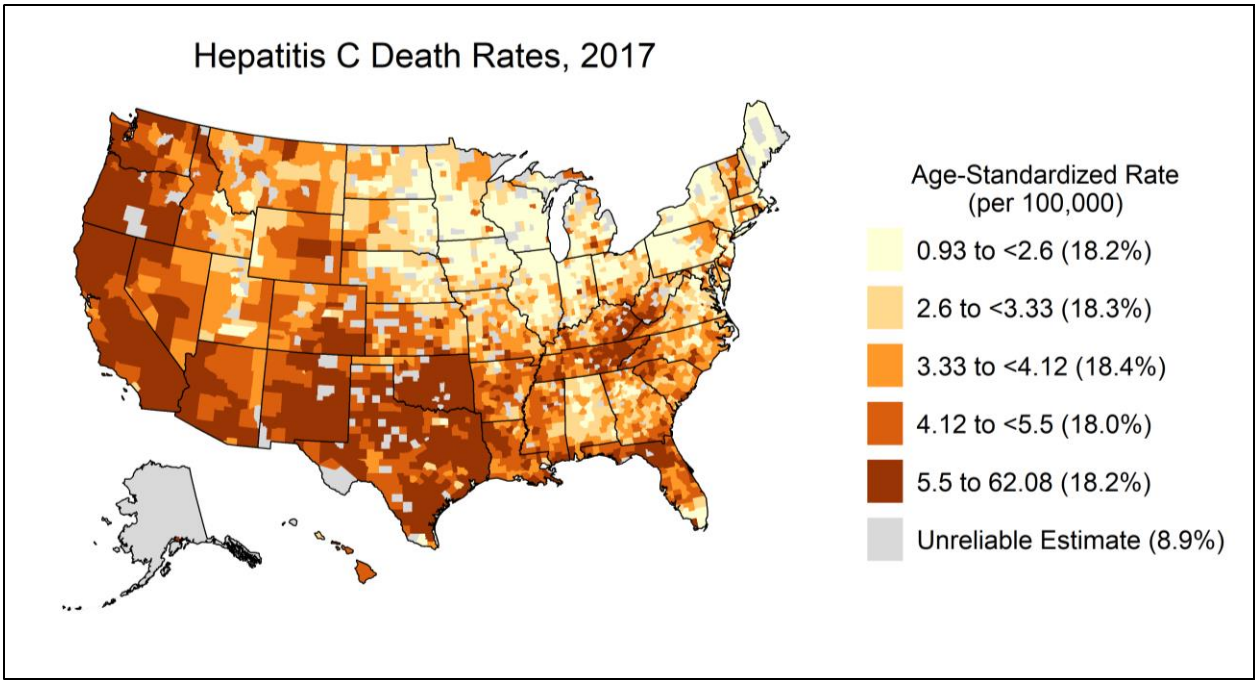
	National			*County-level*		
Rates	**rate**	**95% CI**		**median**	**IDR**	
All ages						
2005 rate (per 100,000)	3.83	3.77	3.89	2.93	1.75	5.03
2013 rate (per 100,000)	5.20	5.12	5.26	4.12	2.52	7.40
2017 rate (per 100,000)	4.34	4.28	4.41	3.66	2.19	6.77
<40 years old						
2005 rate (per 100,000)	0.27	0.26	0.27	0.24	0.19	0.33
2013 rate (per 100,000)	0.18	0.17	0.19	0.19	0.15	0.25
2017 rate (per 100,000)	0.23	0.22	0.24	0.24	0.18	0.36
40+ years old						
2005 rate (per 100,000)	8.56	8.40	8.68	6.49	3.80	11.27
2013 rate (per 100,000)	11.84	11.65	11.98	9.33	5.65	16.83
2017 rate (per 100,000)	9.77	9.65	9.94	8.19	4.80	15.35
Trends (all ages)	**change**	**95% CI**		**median**	**IDR**	
Average annual percent change (%)						
2005 to 2013	3.17	3.00	3.34	4.11	0.97	7.19
2013 to 2017	-4.69	-5.01	-4.33	-3.09	-7.36	1.92
Absolute change (per 100,000)						
2005 to 2013	1.37	1.26	1.46	1.13	0.38	2.85
2013 to 2017	-0.86	-0.93	-0.76	-0.40	-1.30	0.37

Abbreviations: CI, credible interval; IDR, inter-decile range (10^{th} and 90^{th} percentiles)

County-level HCV Death Rates and Trends

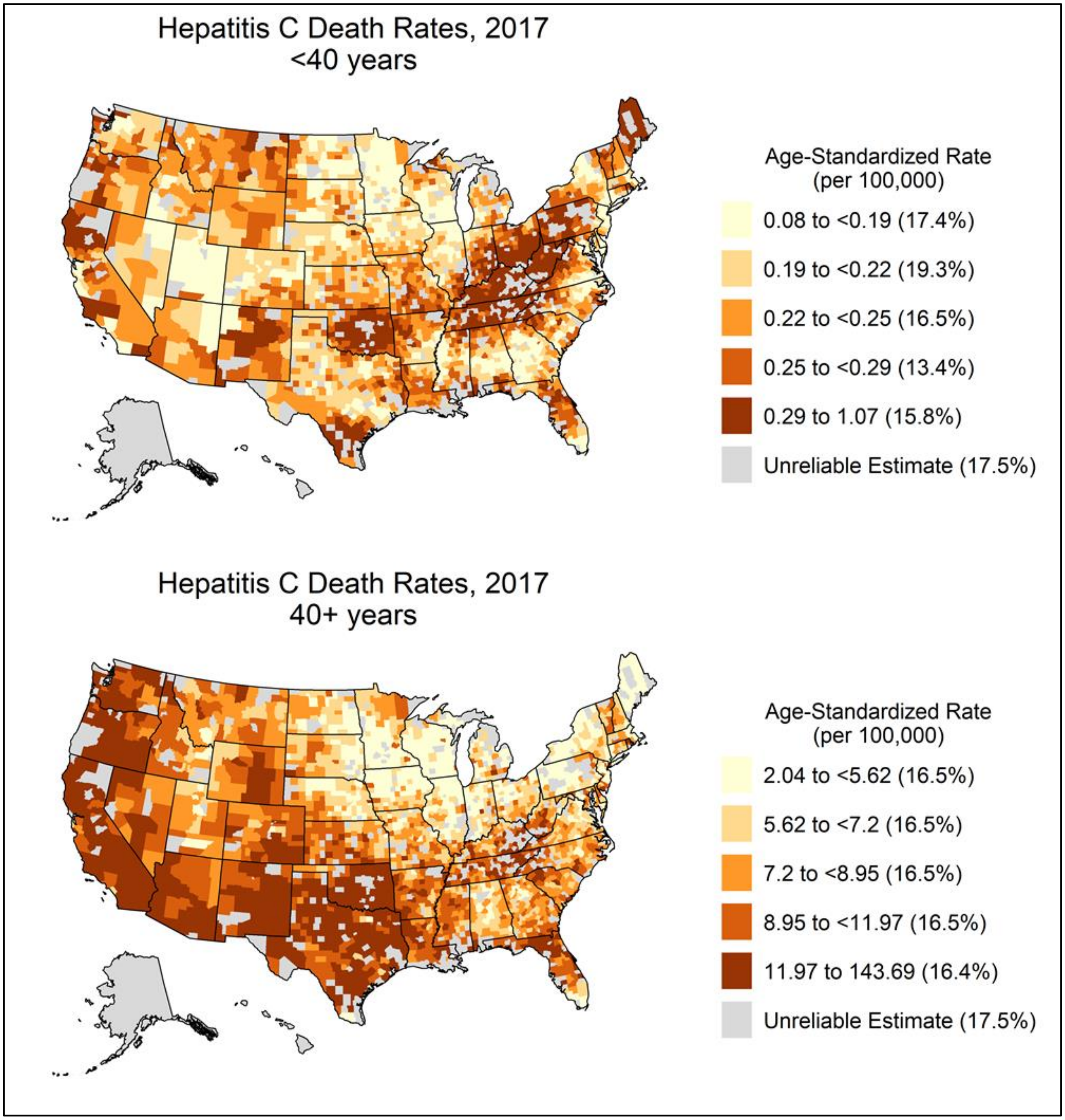
The overall median county-level HCV death rate was lower than the national average (2017 median rate=3.66, interdecile range: 2.19, 6.77). In 2017, 61.0% (n=1732) of counties with reliable rate estimates had an age-adjusted HCV death rate lower than the National Progress Report 2020 Goal of 4.17 per 100,000[96] (Supplemental Table 1). The spatial pattern of HCV death rates in 2017 indicated the highest rates are primarily concentrated in the West, Southwest, Appalachia and northern Florida (Figure 4). Stratifying the 2017 HCV death rates by age group reveals the emergence of some key spatial trends. The highest burden of HCV death rates among persons <40 years of age occurred in New Mexico, Oklahoma and Appalachia, primarily in a geographic band that stretches from Tennessee through Pennsylvania (Figure 5). In contrast, the highest burden of HCV deaths among adults >40 were concentrated along the West coast in and in the southwest.

Figure 4. Age-Standardized HCV Death Rates, by U.S. County, 2017



Note: Any counties that have at least one unreliable rate estimate between 2005 and 2017 are suppressed as unreliable.

Figure 5. Age-Standardized HCV Death Rates by Age Group, U.S. Counties, 2017

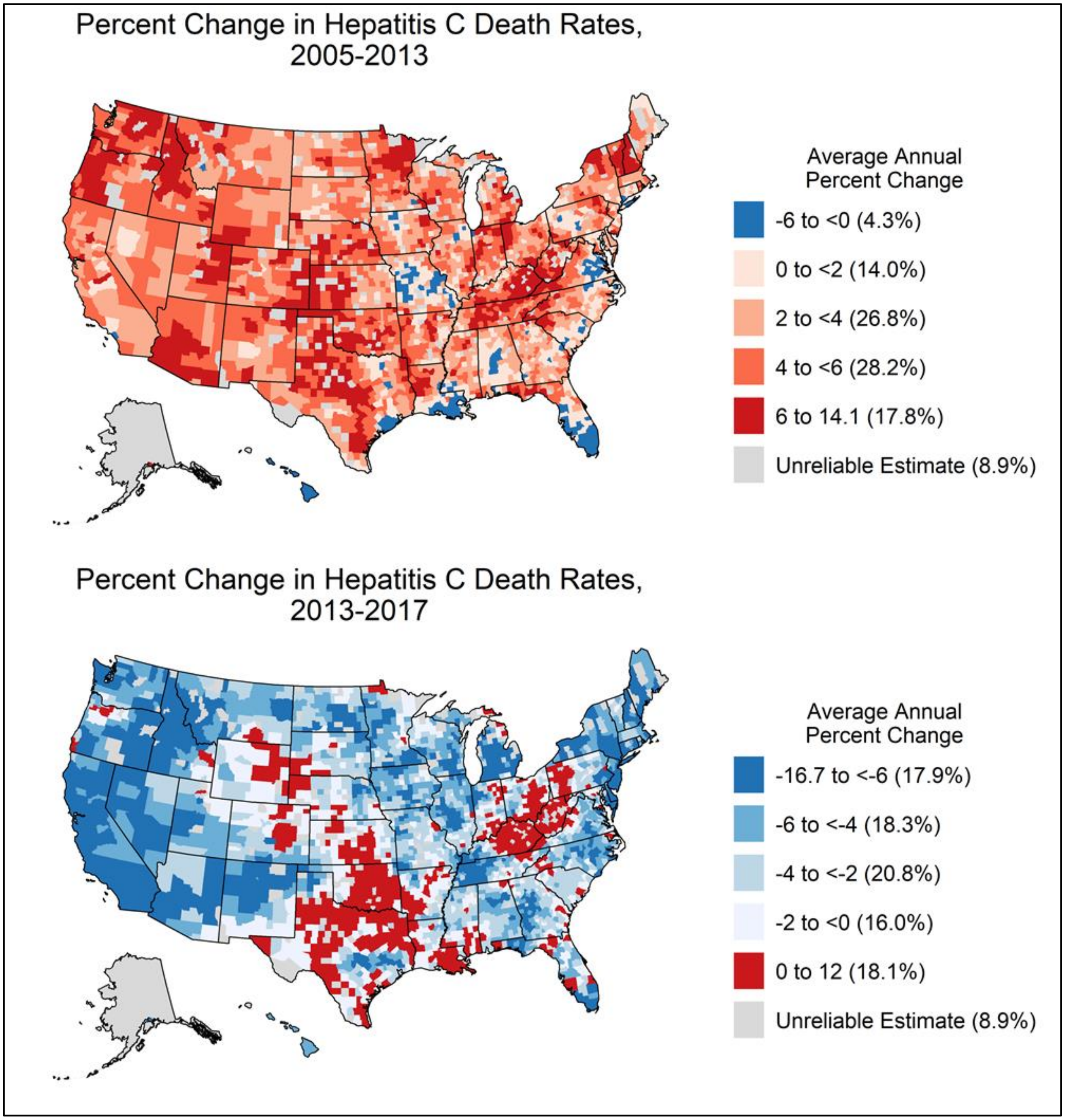


Note: Any counties that have an unreliable 2017 rate for either age group are suppressed as unreliable in both panels. All rates are age-adjusted to the 2000 U.S. Standard Population. Scales for each map differ.

Of the 2839 counties with reliable rate estimates for all years, HCV mortality increased in 95.3% (n=2705) of counties from 2005 to 2013. Counties that did not experience an increase in HCV death rates during this timeframe were primarily centered around urban areas, such as St.

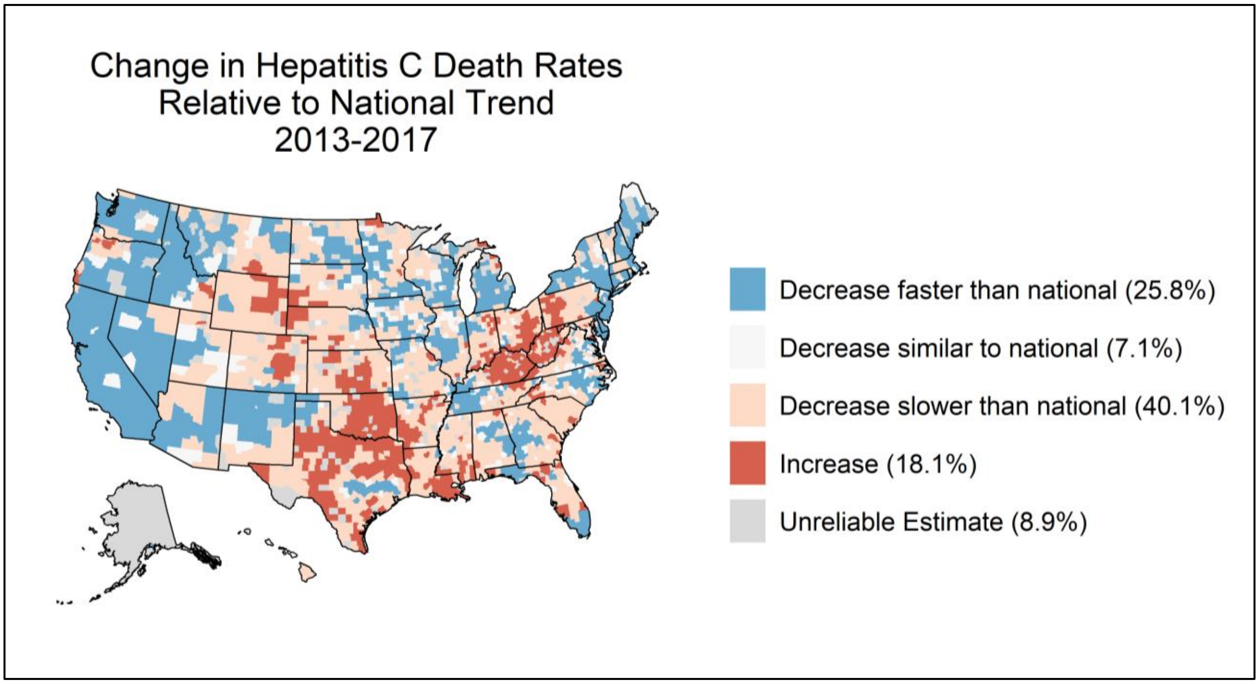
Louis, New Orleans, Miami, Washington D.C., and New York City (Figure 6). In contrast, 80.0% (n=2274) of counties with a reliable trend estimate experienced a decrease in HCV mortality between 2013 and 2017. Counties that had an increase in HCV mortality during this time frame were concentrated in Oklahoma, Texas and parts of Appalachia stretching from Kentucky up through western Pennsylvania. A total of 803 counties (25.8%) had a decline in HCV mortality that was faster than the national decline (average annual percent change between 4.33% and 5.01%) during this time period (Figure 7). Many of these counties were located in the plains states, in Michigan and Wisconsin and in the northeast.

Figure 6. Average Annual Percent Change in HCV Death Rates, All Ages, by U.S. County



Note: Any counties that have at least one unreliable rate estimate between 2005 and 2017 are suppressed as unreliable. All rates are age-adjusted to the 2000 U.S. Standard Population. Scales for each map differ.

Figure 7. Change in County-level HCV Death Rates Relative to National Trend, 2013-2017



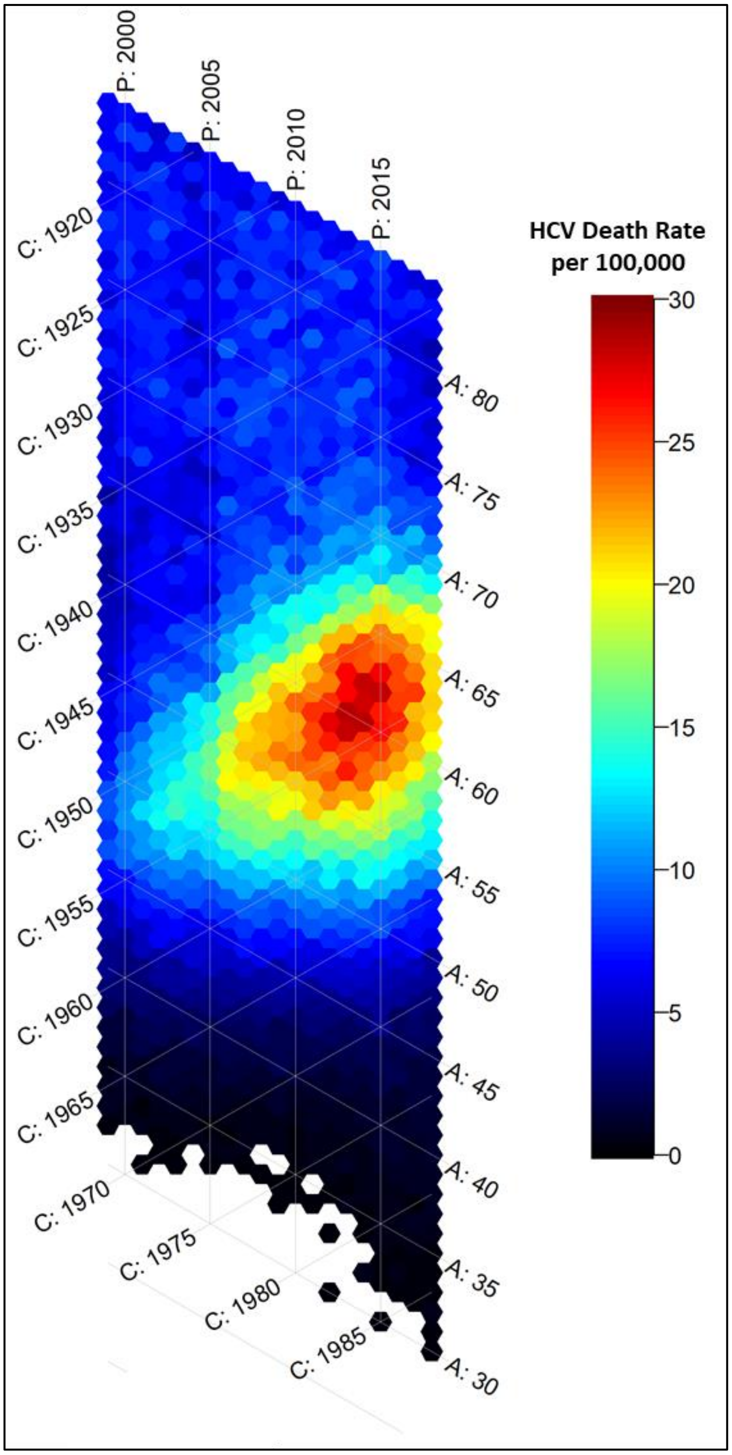
Note: Counties that have an estimated average annual percent change that is within the 95% credible interval of the estimated national average annual percent change (-5.01% to -4.33%) are categorized as decreasing at a pace similar to the national trend. To present a consistent set of counties, any counties that have at least one unreliable rate estimate between 2000 and 2017 are suppressed as unreliable. All rates are age-adjusted to the 2000 U.S. Standard Population.

Discussion

These results illustrate there has been a widespread shift in HCV mortality trends since 2013, but the magnitude and composition of that shift have occurred differently by place and age group. Prior to 2013, increases in HCV death rates were widespread throughout the country. Although national HCV mortality trends reversed in 2013, there is much more heterogeneity in recent trends at the county-level. Since 2013, decreasing national trends are driven primarily by large, decreasing HCV death rates in the West, Southwest and Northeast. However, roughly 1 in 5 counties have experienced an increase in HCV death rates during this same time period and these counties are disproportionally concentrated in Texas, Oklahoma and Appalachia and the counties surrounding New Orleans.

There are a few possible explanations for the reversal of HCV mortality trends since 2013. First, as a result of elevated underlying prevalence and years of targeted screening, the large majority of diagnosed chronic HCV infections are among adults born between 1945 and 1965.[29] As members of this birth cohort aged and the severity of their infections progressed, HCV death rates were expected to increase. Accordingly, after a large proportion of this high burden birth cohort dies, overall HCV death rates are expected to fall. Figure 8 displays national HCV death rates by age (in single years), birth cohort and year to illustrate this birth-cohort effect. Second, since the introduction of curative treatment in the form of direct-acting antiviral (DAAs) agents in 2011, there is some evidence that mortality due to HCV-related cirrhosis has been decreasing on the national-level.[110] Given that DAAs can cure approximately 90% of persons with an HCV-infection within 8-12 weeks with a well-tolerated, oral therapy regimen, their introduction would be expected to lower HCV-related mortality.[111] However, access to treatment is not widespread[43], and the short time frame makes it difficult to attribute county-level declines in HCV mortality to successful treatment initiatives. It is important to note that earlier this year, both CDC[43] and the United States Preventive Services Task Force[112] updated their respective screening guidelines to recommend HCV screening at least once in a lifetime for all adults 18 years of age or older[43], and it is unclear how this will impact current HCV mortality trends. Although adherence to guidelines should theoretically result in the identification of additional HCV infections, which could potentially increase HCV death rates, it should also result in additional persons receiving therapy, which could decrease HCV mortality. The continued monitoring of trends in county-level HCV death rates can provide additional insight on the impact new guidelines may have on mortality.

Figure 8. Hexamap of birth-year cohort patterns in HCV Death Rates, United States, 1999-2018



Abbreviations: C, birth year cohort; P, period (i.e. year); A, age.
Hexamap data visualization methodology developed by Jalal et al.[113]

In addition to understanding trends in HCV mortality, the spatial distribution of age-specific HCV death rates provides additional cross-sectional insight on the current HCV epidemic. HCV death rates are much higher in adults over 40 years of age throughout the time frame of interest, which aligns with expectations for two reasons. First, for all years of study in this analysis, the well-described high-burden birth cohort (born 1945-1965) is included in the older age group. Second, the progression of chronic liver disease caused by HCV infection develops slowly and often does not show symptoms for the first 20 years of infection.[43] Although the magnitude and variability in county-level HCV death rates is much smaller among persons <40 years of age, the spatial pattern provides additional emphasis areas of concern for increasing HCV incidence rates among young adults. Counties in the highest quintile of HCV death rates among persons <40 are disproportionately concentrated in Appalachia (from Tennessee up through Pennsylvania) and Oklahoma, which are areas that have been known to be impacted by increases in injection drug use as a result of the opioid crisis and rising viral hepatitis incidence rates.[79,80,114]

The combined interpretation of cross-sectional death rates and temporal trends provides geographic context to the current bimodal nature of the HCV epidemic. As previously noted, in 2017 the highest HCV death rates were concentrated in the West, Southwest, Appalachia and northern Florida, but age-stratification and trend analysis reveal differences between these regions. For example, high overall county-level HCV death rates in the West and Southwest have primarily been driven by high rates among older (40+ years) adults, and these rates are declining. This is in contrast to many of the counties in Appalachia, in which the overall HCV death rate is increasing and seems to be driven by high HCV mortality among persons aged <40 years. Finally, there are select counties around Oklahoma and northern New Mexico in which high HCV mortality is occurring in older adults and emerging among persons under 40 years.

This emergence of HCV mortality among adults <40 provides additional support for the expansion of HCV screening recommendations to include adults of all ages.[43]

Importantly, these results provide an additional granular data point that can be used to better understand the distribution of viral hepatitis infection in general. Systematic, accurate and timely measurements of incidence, prevalence and mortality are essential for describing the epidemiological burden of any health condition, but these indicators are not consistently available on a small geographic scale for viral hepatitis. State health departments are responsible for identifying and reporting incident HCV cases, but many states lack adequate funding, and surveillance practices are inconsistent across jurisdictions.[18] Nationally representative survey data has been used in small-area estimation models to estimate state-level HCV prevalence[27], but updates to those estimates are reliant on model assumptions, and long delays between survey cycles limit utility. Although these results do not replace the need for a comprehensive and cohesive viral hepatitis surveillance system, these granular and temporal data on HCV mortality provide an important metric for understanding the evolution of the HCV epidemic.

In addition to using the HCV-related death rate as a key indicator in monitoring progress of national viral hepatitis action plans[85,86], local jurisdictions can use these data to evaluate HCV mortality in their area relative to surrounding areas and the nation as a whole. A better understanding of where high HCV mortality is occurring can inform the allocation of public health resources and interventions that aim to reduce HCV mortality or infection. For example, providing HCV screening along with medication assisted treatment and syringe-service programs has been shown to be a cost-effective strategy in reducing HCV infection.[115] These data can help inform where syringe service programs, or any other interventions that increase access to HCV screening or linkage to care, should be located.

Limitations

The main limitation of this study is the potential for misclassification of HCV-related deaths through the use of death certificate data. Although deaths that include an HCV death code are not expected to be misclassified, viral hepatitis is often undiagnosed and underreported as cause of death on death certificates.[116] However, this method of death classification has been constant over time and changes in underreporting would be unlikely to explain temporal trends. Additionally, data in the National Vital Statistics System includes all recorded deaths in the United States, which reduces concerns about selection bias or generalizability. Age-standardized death rates may not be equivalent to actual observed death rates, but age-standardization was appropriate in this analysis for comparisons across the population and time as the age-distribution of the population changes. Finally, previous work has indicated that race/ethnicity and sex disparities in chronic HCV prevalence differ on the state-level[28], and there may also be demographic disparities in county-level mortality trends. Future research should explore and quantify demographic disparities in these spatiotemporal trends.

Conclusion

Hepatitis C death rates have been declining since 2013, but the direction and magnitude of that trend is not consistent by place or age group. Efforts to continue the national decline in HCV mortality will require innovative approaches that increase access to testing and care for persons living with HCV infection, particularly in counties in which HCV death rates continue to remain high.

Chapter 3: Describing the Changing Relationship between Opioid Prescribing Rates and Overdose Mortality: A Novel County-Level Metric

Abstract

Background: In the United States, the rate of drug overdose death has more than tripled over the past two decades, a trend that is often attributed to changes in opioid prescribing practices. Although national opioid prescription rates began declining in 2012, national overdose mortality has continued to rise. We aimed to develop a novel longitudinal metric that summarizes the relationship between prescription opioid prescribing practices and drug overdose mortality and to assess if longitudinal changes in that relationship differ by characteristics of place.

Methods: We used National Vital Statistics System drug overdose mortality data and opioid prescribing data from IQVIA Xponent to construct a single county-level measure of overdose deaths per 100,000 opioid prescriptions for each year from 2006 to 2017. Additionally, we used latent profile analysis to classify all U.S. counties into county-type classes based on demographic and socioeconomic indicator variables hypothesized to be associated with opioid prescribing rates. We plotted temporal trends in the relationship between prescription opioid availability and overall drug overdose death rates and fit a mixed Poisson log-linear model to quantify temporal change by county-type classes.

Results: Latent profile analysis included 23 county-level indicators from 3142 U.S. counties. The selected model resulted in 7 classes (named: average counties, farming/mining, farming-dependent, poverty 1, poverty 2, high education, and high GDP) with high separation between classes (overall entropy=0.916). From 2006 to 2017, opioid prescription rates were consistently

highest among counties in the poverty 2 class (91.3 per 100 persons in 2017) and lowest among counties in the farming/mining (45.9 per 100 persons in 2017). Similarly, overdose deaths were consistently highest among counties in the poverty 2 class (26.9 per 100,000 persons in 2017) and lowest among counties in the farming/mining or farming-dependent classes (14.3 and 16.5 per 100,000 persons, respectively, in 2017). Across all groups, the average number of overdose deaths per opioid prescription remained steady from 2006-2011 before increasing from 2012-2017. The largest increases were in the high GDP (average annual change: 18.8%, 95%CI: 18.2, 19.4) and high education classes (18.5%, 95%CI: 17.9, 19.2).

Conclusion: Opioid prescribing practices and drug overdose mortality both continue to be ongoing public health challenges, but how they interact differs by geography and place characteristics. This novel summary metric provides an additional data point that can used to enhance our understanding of the shift in overdose mortality away from prescription opioids to other drugs. Additional innovative data sources are needed to provide further clarity of small-area shifts in overdose mortality and guide locally-relevant efforts to prevent drug overdose deaths.

Publication

To be submitted to TBD.

Introduction

Between 1999 and 2017, the rate of drug overdose death in the United States more than tripled, with over 67,000 overdose deaths occurring in 2017 alone.[117] This increase in overdose death is primarily attributed to changes in opioid prescribing practices, which began with physicians overprescribing opioids in the 1990s.[118] As a response, the public health community implemented several measures to curb overprescribing practices (e.g. prescribing guidelines, prescription drug monitoring programs, PDMPs), and the national rate of opioid prescriptions began declining in 2012. Despite recent success in reducing opioid prescribing rates, the number of opioid prescriptions continues to remain high, with 15% of the U.S. population filling at least one opioid prescription in 2018.[119] Moreover, the rate of overdose deaths continued increasing despite declining opioid prescription rates,[119] due largely to an increasing percentage of overdose deaths attributable to illicit opioids and other drug types.[120] Closer analysis of the specific types of opioids implicated in overdose mortality led to understanding the national opioid epidemic as occurring in three waves[119]: an increase in prescription overdose deaths that began in the 1990s[121] (Wave 1); a sharp increase in heroin-related deaths that began in 2010[122] (Wave 2) and a dramatic increase in deaths involving synthetic opioids that began in 2013[123] (Wave 3).

We have observed temporal changes in both national opioid prescribing practices and overdose deaths, but there is limited information on the changing relationship between the two and, in particular, how that change has occurred on a more granular geographic level. Understanding the changing relationship between opioid prescribing practices and overdose mortality on a sub-national level is important for two reasons. First, many health and social services are delivered at the county or local-level and the differentiation between overdose deaths due to prescription opioid misuse versus overdose deaths due to illicit opioids use (e.g. heroin, illicitly manufactured fentanyl) can help inform distinct prevention strategies.[124] Interventions to combat overdose deaths from prescription opioids often target high-risk prescribing practices (e.g. prescribing guidelines, PDMPs), whereas interventions to combat overdose deaths involving illicit opioids often focus on harm reduction (e.g. naloxone access, supervised injection sites) or reducing illicit drug supply (e.g. law enforcement strategies).[125] Although most proposed public health approaches agree that a combination of interventions is needed[118,125-128], the composition of that combination should be appropriately tailored to the local characteristics of the epidemic.

Additionally, national data on prescribing practices and overdose mortality may mask trends occurring at more granular geographic levels and those trends may differ by county-level characteristics. Although national opioid prescription rates peaked around 2012, trends in prescribing practices have likely differed by county.[129] Similarly, research has indicated that the drugs involved in overdose deaths do differ by region[130], but jurisdictional differences in toxicology testing capability and changes in reporting practices make it difficult to use death record data to assess differences in drug-type overdose deaths on a smaller geographic (i.e. county) level. The identification of places in which the interaction between these two measures may differ from national trends can lay the framework for investigating why these differences occur.

Analyzing county-level trends in drug overdose mortality has become increasingly important for understanding geographic patterns and how local characteristics may impact the epidemic. There is a growing body of literature that focuses on using population characteristics to help identify places with high risk of opioid misuse.[131-136] For example, a recent paper by Monnat el al.[131], demonstrated that county-level drug mortality rates are higher in counties with more economic disadvantage and higher rates of opioid prescribing. This growing literature suggests that the overdose epidemic in a specific place is impacted by the interaction between local structural factors and drug availability. Building on that literature, we took a two-pronged approach to 1) develop a novel longitudinal metric that summarizes the relationship between prescription opioid prescribing practices and drug overdose death; and 2) determine if longitudinal changes in that relationship differ by characteristics of place.

Methods

We constructed a single measure, overdose deaths per 100,000 opioid prescriptions, that relates prescription opioid availability and drug overdose death for all U.S. counties. Next, we used latent profile analysis (LPA) to classify all U.S. counties into county-type classes based on county-level indicator variables that were associated with opioid prescription rates. Finally, we plotted and quantified temporal trends in the relationship between prescription opioid availability and overall drug overdose death rates by county-type class. Longitudinal analyses of trends were limited to 2006-2017 and the unit of analysis was counties. We used SAS 9.4 (SAS Institute, Cary, NC) for all statistical analysis, Mplus version 8 (Muthen & Muthen, Los Angeles, CA) for all LPA modeling and RStudio for all data visualization. Because this study used publicly available county-level data, institutional review board approval was not necessary. The data sources and approach are described in detail below.

Data Sources

Drug overdose mortality

Annual county-level data on drug overdose mortality are model-based estimates published by the National Center for Health Statistics (NCHS).[137] Data from NVSS multiple cause-of-death mortality files were classified as a drug overdose death if they listed any of the following International Classification of Diseases, Tenth Revision (ICD-10) codes: X40-X44 (unintentional), X60-X64 (suicide), X85 (homicide) or Y10-Y14 (undetermined intent). NCHS then used hierarchical Bayesian models with spatial and temporal random effects to generate stable estimates of annual drug overdose deaths per 100,000 population for every county from 1999 to 2017.

Opioid prescription availability

Centers for Disease Control (CDC) National Center for Injury Prevention and Control reports the annual number of opioid prescriptions dispensed per 100 population from 2006-2017 for all U.S. counties.[138,139] Opioid prescription rates use IQVIA Xponent data, which is based on a sample of approximately 50,000 pharmacies that dispense 90% of all retail prescriptions. Each prescription is an initial prescription or refill that is paid for by commercial insurance, Medicaid, Medicare or cash. Cold medicines containing opioids, buprenorphine products commonly used to treat opioid disorder and methadone dispensed through treatment programs were not included in calculation of opioid prescription rates.

County-level indicators for latent profile analysis

We conducted a latent profile analysis as a data reduction method to summarize county-level characteristics that could interact with our relationship of interest. Through a social-ecological model framework[140], we identified county-level indicators that were hypothesized to be associated with prescription opioid availability on the individual, relationship, community or societal level (Supplemental Figure 1). To be considered for inclusion, data had to be cross-sectional from 2013 or later and be publicly available on the county level. Potential indicators that had missing values for more than 10% of counties or reflected resource allocation or local policies were not included. Using this criteria, we compiled a set of indicators from the following data sources: U.S. Department of Agriculture[141], U.S. Bureau of Economic Analysis[142], U.S. Department of Education[143], Robert Wood Johnson County Health Rankings[144] and the American Community Survey[145] (Supplemental Table 2).

<u>*Analysis*</u>

Latent profile analysis

The goal of the latent profile analysis was to classify counties based on county-level characteristics that are associated with opioid prescription availability. Latent profile analysis (LPA) is a type of mixture modeling that models categorical latent variables that are representative of classes where membership is not known, but rather inferred from the analysis.[146,147] All eligible county-level indicator variables were compiled and the most recent year of data (between 2013 and 2017) was selected for each variable. Only indicators that were associated with county-level opioid prescription rates in 2017 were included in latent profile models. One-way ANOVA, Kruskal Wallis and Pearson's Correlation Coefficient tests were used (where appropriate) to assess the association between each potential indicator and 2017 opioid prescription rates. Potential indicators that had a p-value <0.05 were retained for use in LPA. The following indicators were included: county typology, gross domestic product (GDP), percent change in GDP from 2014-2015, households with a severe housing problem, life expectancy, adequate food access, children eligible for reduced price lunch, chronic absenteeism, grandparents responsible for their grandchildren, completion of high school, completion of college, population mobility, proportion of homes that are mobile homes, employment to population ratio, health insurance coverage, poverty, racial segregation, premature death, violent crime offenses, births that are low birthweight, adult smoking, adult excessive drinking, driving deaths involving alcohol, children in poverty and income inequality (Supplemental Table 2).

Each county-level indicator was included in the LPA as an individual item and, because we did not know the number of classes that should be represented by these data, an exploratory approach was taken to fit several models. The correlation between individual items was initially fixed at zero, but this was relaxed to allow items with correlation coefficients stronger than 0.7 to correlate within class.[148] All models were fit using maximum likelihood parameter estimation with robust standard errors using automatic starting values with random starts (initial stage starts=600; final stage optimizations=20). For each model, replication of the best log-likelihood was confirmed to ensure a global solution was found. We required potential models to have a minimum smallest class size of at least 50 counties and compared fit statistics (i.e. Bayesian Information Criteria, BIC; Akaike Information Criteria, AIC; Adjusted BIC) and accuracy statistics (e.g. entropy[149]) to select the final model.[148] Each county was classified into a latent class group (i.e. county-type class) by the largest class probability indicated in the final model. To qualitatively describe each latent class group, we standardized the average value of each item within each group and compared to the national mean for each item.

Construction of overdose deaths per opioid prescriptions measure

We multiplied county-level drug overdose rates by county-level population size estimates to get model-based total number of overdose deaths per county and year. Similarly, we multiplied county-level opioid prescriptions rates by population size estimates to get the total number of opioid prescriptions dispensed by county and year. Total overdose deaths, opioid prescriptions and population sizes were aggregated to calculate opioid prescriptions per 100 persons and drug overdose death per 100,000 for each county-type class and year. Additionally, we calculated the total number of overdose deaths per 100,000 opioid prescriptions for each individual county and each county-type class per year.

To quantify temporal changes in the relationship between overdose death and prescription opioid availability, we fit a mixed Poisson log-linear model with the number of overdose deaths as the outcome and opioid prescriptions as the offset. The model contained fixed effects for year, county-type class and a year by county-type class interaction (formula below). Additionally, the model contained a random intercept for county. Model coefficients were used to estimate the average annual change (and 95% confidence interval) between 2006-2011 and 2012-2017 for each county-type class.

$$\ln(Drug\ Overdose_{ij}) = \beta_0 + \beta_{0j} + \beta_1 * County\ type\ class_j + \beta_2 * Year_i + \beta_3 * County\ type\ class_j * Year_{ij} + \ln(Opioid\ Prescriptions_{ij})$$

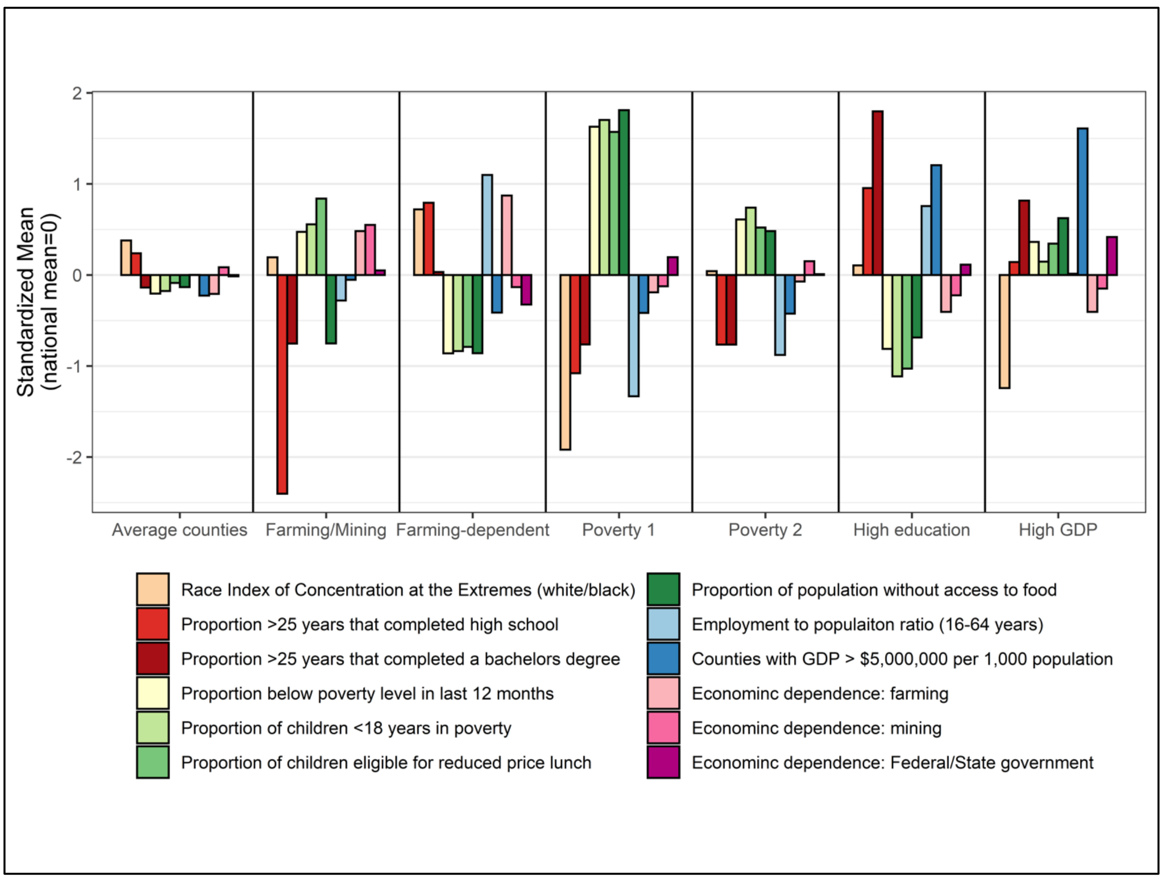
Where: i=year and j=county.

Results

The latent profile analysis included 23 county-level indicators from 3,142 U.S. counties (Supplemental Table 2). We attempted to fit 12 total models that ranged from 5 to 12 classes (Supplemental Table 3). When assuming no correlation within classes, models with more than 10 classes were unable to find a global solution. When allowing correlation between pairs of items with correlation coefficients stronger than 0.7, models with more than 7 classes were unable to find a solution. Among models that found a global solution, we selected the model with the lowest AIC (-107746.0) and BIC (-106075.5), resulting in a final model that included seven latent classes and allowed correlation within classes. The selected model demonstrated strong classification confidence and indicated high separation between latent classes (overall entropy=0.916). The minimum class size was 123 counties and the minimum class probability was 0.919.

For each latent class group, the standardized mean values of all latent class items that had an entropy value >0.3 are shown in Figure 9. The farming/mining class was the smallest class (n=123, 3.9% of all counties) and consisted of counties with the lowest proportion of adults >25 years of age that have a high school education (class mean=70.6%; Supplemental Table 4). The poverty 2 class (n=576, 18.3%) also had education levels below the national average, but higher high school graduation rates (81.2% of persons >25 years) compared to the farming/mining class. The farming-dependent class (n=559, 17.8% of all counties) contained a large proportion of counties (44.5%) that have an economic dependence on farming. The poverty 1 class, (n=318, 10.1%), was characterized by the highest racial diversity (race index of concentration at the extremes mean=0.281), highest poverty rates (group mean=26.7% in poverty in past year) and lowest levels of employment (mean employment ratio=0.66). The high education class (n=395, 12.6%) had the highest proportion of adults 25 years or older with a high school degree (mean=92.4%) and college degree (mean=37.9). The majority (74.4%) of counties in the high GDP class (n=219, 7.0%) have an annual GDP greater than $5,000,000 per 1,000 persons. The average counties class had the largest number of counties (n=952, 30.3%) and was comprised of counties that closely resembled the national mean across all items.

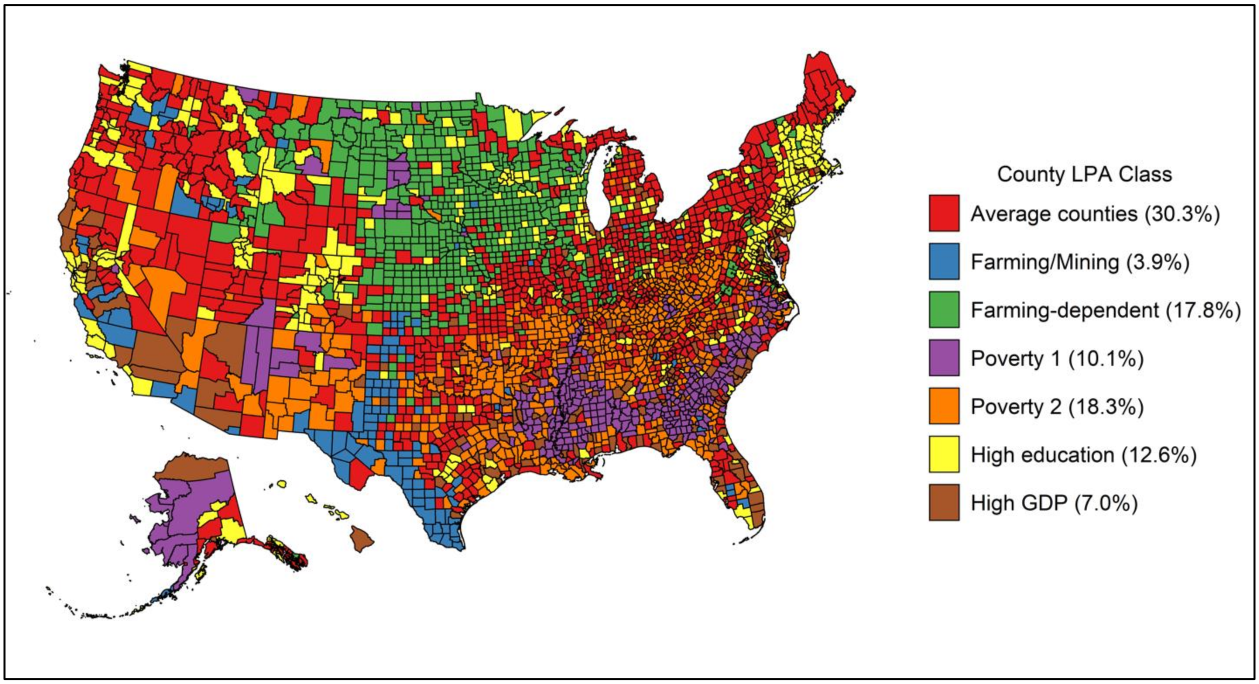
Figure 9. Standardized means of most influential latent profile analysis county-level indicators, by class



Note: All indicators that have a variable specific entropy > 0.3 are represented. Class-level means are standardized to the national mean. Abbreviations: GDP, gross domestic product.

Although the latent profile analysis did not contain any specific geographic indicators, some of the resulting classes displayed noteworthy spatial patterns (Figure 10). Counties in the farming-dependent class were primarily concentrated in upper Midwest in an area that stretched between eastern Montana, Kansas and Wisconsin. The majority of counties from the poverty 1 class were concentrated among states located in the South and along the Atlantic Coast across an area between Louisiana and North Carolina. Similarly, a large portion of counties in the poverty 2 class were located in New Mexico or the area from east Texas through Appalachia.

Figure 10. Map of county classification based on latent profile analysis of county-level indicator variables associated with opioid prescription rates

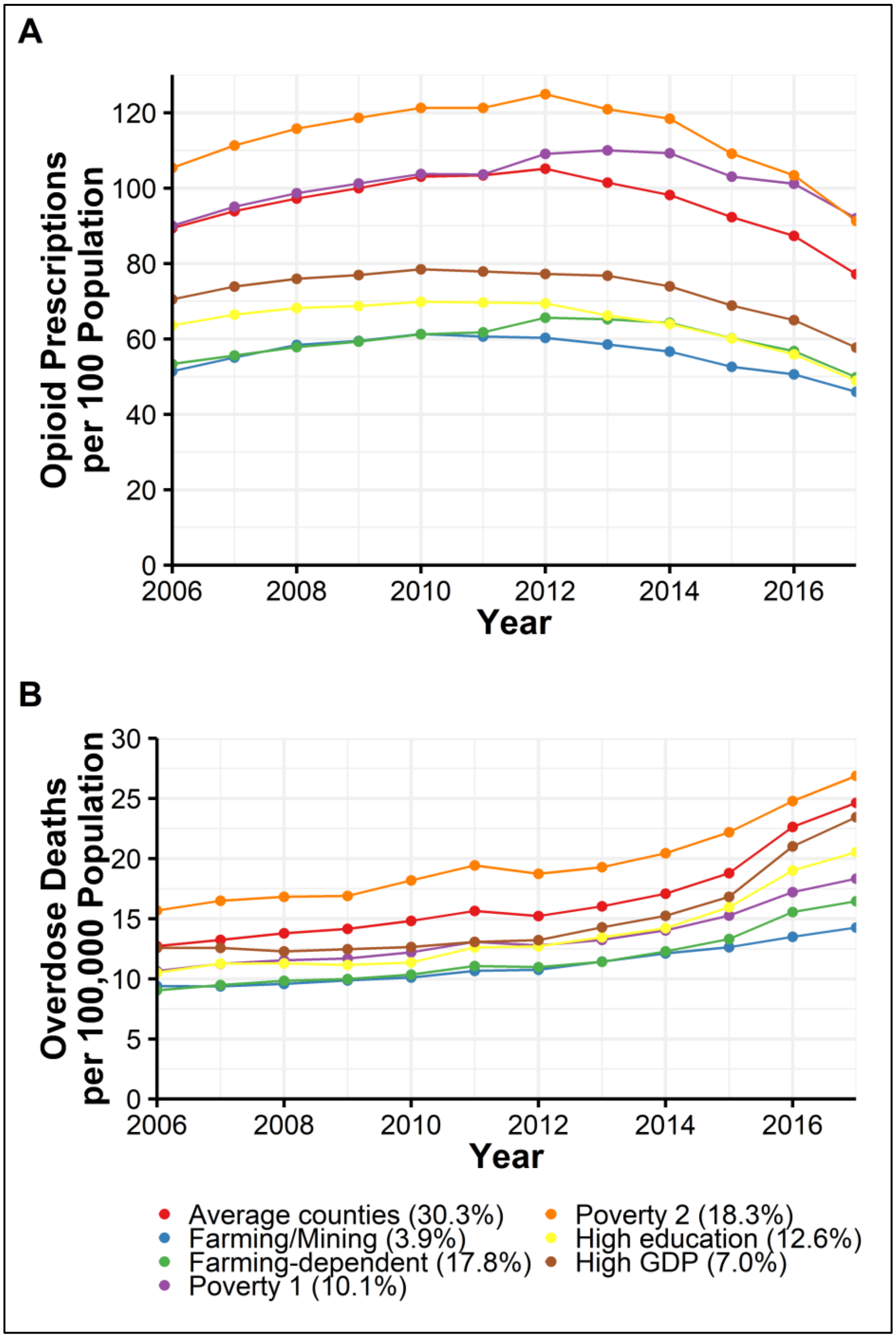


Abbreviations: LPA, latent profile analysis; GDP, gross domestic product.

Temporal trends in opioid prescription rates followed a similar pattern for all groups, with the majority of groups experiencing a gradual increase in opioid prescriptions per 100 persons from 2006 to 2012 followed by a decrease in prescription rates from 2012 to 2017 (Figure 11, panel A). From 2006 to 2017, opioid prescription rates were consistently highest among counties in the poverty 2 class (105.4 per 100 persons in 2006; 91.3 per 100 persons in

2017) and lowest among counties in the farming/mining class (51.4 per 100 persons in 2006; 45.9 per 100 persons in 2017). Similarly, across the time period, overdose deaths per 100,000 persons were consistently highest among counties in poverty 2 class (2006: 15.7; 2017: 26.9) and lowest among counties in farming/mining class (2006: 9.4; 2017: 14.3) or farming-dependent class (2006: 9.0; 2017: 16.5) (Figure 11, panel B).

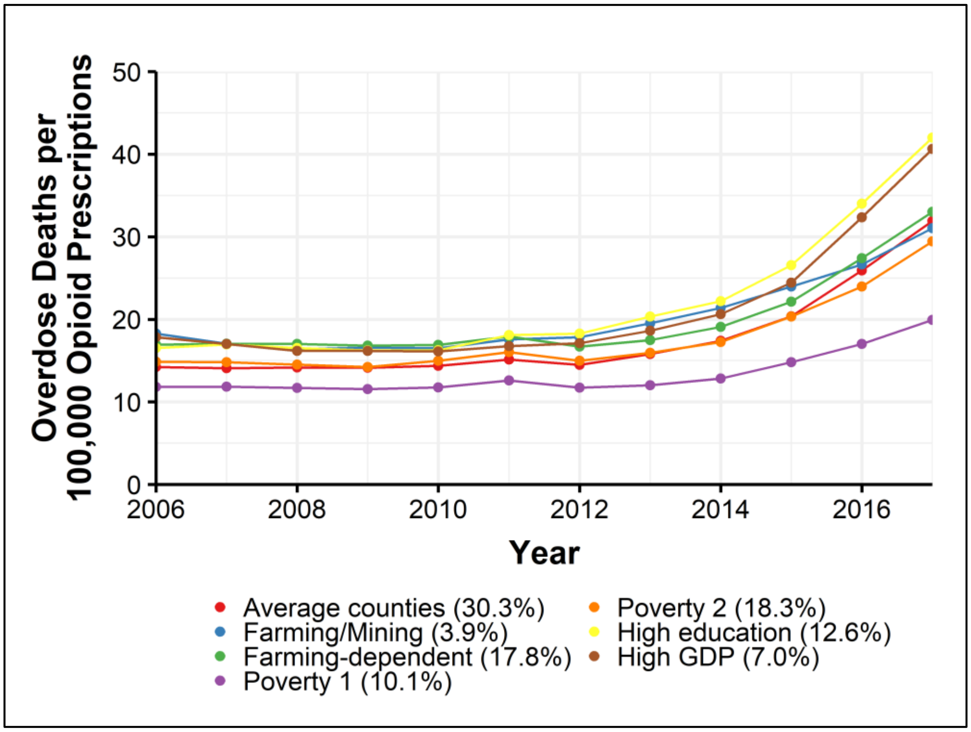
Figure 11. Trends in drug overdose deaths and opioid prescription availability by class, United States, 2006-2017



Note: (A) Opioid prescription rates are based on a sample of approximately 50,000 retail (non-hospital) pharmacies, which dispense nearly 90% of all retail prescriptions in the United States.[138,139] (B) County-level overdose deaths are model based estimates.[137] Overdose deaths are classified using the International Classification of Diseases, 10th Revision and identified using underlying cause-of-death codes X40–X44, X60–X64, X85, and Y10–Y14. Abbreviations: GDP, gross domestic product.

When comparing the number of overdose deaths per 100,000 opioid prescriptions across place or time, larger values indicate more overdose deaths per number of opioid prescriptions. In 2006, the average number of overdose deaths per 100,000 opioid prescriptions ranged from 11.8 (poverty 1) to 18.3 (low education). By 2017, overall rates had increased and that spread had widened: the average number of overdose deaths per 100,000 opioid prescriptions ranged from 19.9 (poverty 1) to 42.0 (high education; 40.6, high GDP; Figure 12). Between 2006 and 2011, the average number of overdose deaths per opioid prescription remained steady across all groups, with the point estimates of average annual percent change ranging from -1.3% (high GDP; 95% CI: -1.9, -0.7) to 1.9% (high education; 95%CI: 1.3, 2.6) (Table 2). In comparison, from 2012 to 2017 the average number of overdose deaths per opioid prescription increased across all groups. The lowest average annual percent change occurred in poverty 1 (11.5%, 95% CI: 9.1, 13.9) and the largest average annual change was among counties in high GDP (18.8%, 95%CI: 18.2, 19.4) and high education (18.5%, 95%CI: 17.9, 19.2).

Figure 12. Trends in drug overdose deaths per opioid prescription availability by class, United States, 2006-2017



Note: County-level overdose deaths are model based estimates.[137] Overdose deaths are classified using the International Classification of Diseases, 10th Revision and identified using underlying cause-of-death codes X40–X44, X60–X64, X85, and Y10–Y14. Opioid prescription rates are based on a sample of approximately 50,000 retail (non-hospital) pharmacies, which dispense nearly 90% of all retail prescriptions in the United States.[138,139] Abbreviations: GDP, gross domestic product.

Table 2. Average annual percent change in overdose deaths per number of opioid prescriptions, by class, United States, 2006-2017

		2011 vs 2006			2017 vs 2012		
Class	**# of counties**	**Estimate**	**95% CI**		**Estimate**	**95% CI**	
Average counties	952	1.013	1.004	1.022	1.171	1.162	1.180
Farming/Mining	123	0.991	0.965	1.019	1.119	1.092	1.146
Farming-dependent	559	1.011	0.988	1.036	1.151	1.128	1.174
Poverty 1	318	1.015	0.990	1.041	1.115	1.091	1.139
Poverty 2	576	1.017	1.002	1.032	1.150	1.135	1.165
High education	395	1.019	1.013	1.026	1.185	1.179	1.192
High GDP	219	0.987	0.981	0.993	1.188	1.182	1.194

Abbreviations: CI, confidence interval; GDP, gross domestic product.

Discussion

The results of this analysis indicate that opioid prescribing rates and drug overdose mortality both continue to be ongoing public health challenges, but the way they interact differs by geography and place. Although it is evident the number of overdose deaths per number of opioid prescriptions has been increasing across the country since 2012, the magnitude of that increase is different by place-level characteristics of counties. For example, compared to the rest of the country, counties with high GDP that primarily rely on federal or state employment (high GDP class) and counties characterized by higher levels of education and life expectancy (high education class) have experienced a much sharper increase in the number of overdose deaths that occur for a given number of opioid prescriptions. In contrast, as the number of opioid prescriptions decreased in counties with high poverty or counties that are dependent on farming/mining, the concurrent rise in overdose mortality was more gradual than the rest of the country. Although the ratio of overdose deaths per opioid prescription experienced the slowest growth in counties with high poverty, the absolute values of opioid prescriptions and overdose deaths remained the highest in those same counties across the time period.

Summarizing the number of overdose deaths per opioid prescription provides an additional measure that may be used to enhance our understanding of changes in the drug overdose death epidemic. This measure is relatively simple to interpret and has some inherent advantages. First, our use of a non-specific definition of overdose deaths avoids the introduction of biases that arise during attempts to define "prescription opioid-related" deaths. Attempts to classify prescription opioid-related death with drug-specific data from death certificates is challenging because some overdose deaths have missing data on drug type[150], indicate the use of multiple drugs[151] or are unable to distinguish between prescribed fentanyl and illegally manufactured fentanyl.[124] This measure is not intended to replace the analysis of drug types reported on death certificates, but rather to be a complementary data point. Second, we synthesized publicly available longitudinal data points published by CDC that are available to local health departments. Although the scope of this analysis focused on groups of counties that share place-level characteristics, individual jurisdictions may be interested in using this measure to monitor changes in the relationship between opioid prescribing practices and overdose mortality in their specific community. It can be used to triangulate trends seen in more specific local toxicology reports to better understand the shift away from prescription opioid mortality and guide allocation of public health efforts.[124,125]

Public health interventions to reduce opioid overdose mortality are often viewed through three major categories: supply reduction, demand reduction and harm reduction.[125,152] Changes in the new measure reported here can inform the types of interventions to implement. A dramatic divergence in the number of overdose deaths per opioid prescriptions demonstrates that simply reducing the supply of opioid prescriptions is insufficient. For example, sharp increases in this ratio, as seen in the high education and high GDP classes, could indicate there are more opioids being acquired on the black market or users have moved from prescription opioids to more lethal drugs. As a result, public health programs should partially shift their focus away from further reducing overprescribing practices to combating harm reduction (e.g. naloxone distribution, supervised injection sites) and reducing illicit drug supply. Furthermore, the transition away from prescription opioid misuse to other drugs has different implications for routes of administration and potential resulting health consequences. For example, some illicitly manufactured opioids are more likely to be injected, which has led to an increase in bacterial infections[153] and transmission of infectious diseases such as hepatitis C and HIV.[154] Anticipated or observed increases in these resulting health complications could require additional public health responses.

The results of this analysis provide the first step in a more granular understanding of the shift in overdose mortality away from prescription opioids to other drugs. Change in this metric by time and place may be attributable to a combination of population level structural factors, geographic availability and toxicity of drugs and local public health interventions. This metric can be used for a further understanding of why the shift differs by place or county-level characteristics. As additional data elements become available, future research can use this baseline framework to assess the degree to which local characteristics, policies or interventions may be responsible for the observed differences. In Figure 13, we lay out a conceptual framework that expands on the statistical model used in this analysis to incorporate these additional data. For example, using existing data for the type and strength of opioid prescriptions (e.g. through morphine milligram equivalent rates[155]) can determine if changes are due to differences in toxicity of prescriptions opioids. Similarly, improved coordination of real time data from toxicology reports, medical examiners, coroners, law enforcement agencies and crime labs could be used to assess the impact of changes in the availability and potency of non-prescription opioids.[156,157] Data on the availability of harm reduction services (e.g. naloxone distribution programs, safe injection sites, MAT treatment in jails, etc.) could all contribute to the reduction of overdose mortality by county. Finally, the inclusion of data on state-level policies such as Good Samaritan laws or nurse practitioner scope of practice laws can be incorporated to assess their performance in different types of counties. Although several of these data sources currently exist (i.e. state-level policies and laws, legality or funding of harm reduction services), additional data systems are needed to accurately measure the local availability and toxicity of non-prescription opioids and quantify access to harm reduction services.

Figure 13. Conceptual framework and model specification to analyze the number of overdose deaths per opioid prescriptions.

Structural Factors	**Social Services**	**State-level Policies**
• County-level characteristics **Drug Supply** • Potency of opioid prescriptions • Availability of illicitly manufactured drugs	• Medication-Assisted Treatment (MAT) • Syringe exchange programs • Safe injection spaces • Naloxone education • Stigma reduction • MAT-on-demand (e.g. jails, emergency departments) • User-driven fentanyl testing	• Medicaid expansion • Medicaid coverage of methadone • Scope of practice laws for buprenorphine prescription • Good Samaritan laws • Minimum sentencing laws • Syringe services legality

Theoretical model specification

$$\ln(Drug\ Overdose_{ij}) = \beta_0 + \beta_{0j} + \beta_{0k} + \beta_{1ij} * Structural\ Factors_{ij} + \beta_{2ij} * Drug\ Supply_{ij} + \beta_{3ij} * Social\ Services_{ijk} + \beta_{4k} * State\ level\ Polices_k + \ln(Opioid\ Prescriptions_{ij})$$

Where: i=year; j=county and k=state.

Note: For simplicity, model equation does not include all nested fixed effects.

The data sources and approach used in this analysis have a few limitations. The county-level overdose mortality rates are model based estimates generated from death certificate data, which has the potential for undercounting or misclassification.[158] Opioid prescription data is based on a sample from pharmacies that dispense 90% of all retail prescriptions across the country, but it does not include mail order prescriptions and is not a complete census of all opioid prescriptions. Additionally, all data in this analysis are county-level data and specific inferences could be susceptible to ecological fallacy. Finally, this measure provides an additional unique data point to view the changing relationship between prescription opioid rates and overdose mortality, but the current analysis does not take into account any potential drivers of that change.

Historical mortality trends over the past 40 years indicate the U.S. drug overdose epidemic is comprised of several changing sub-epidemics with distinct characteristics.[159] As the substance use patterns continue to evolve, surveillance becomes more complicated and overdose mortality prevention efforts become more challenging. A better understanding of the interaction between drug availability and place characteristics can inform locally-relevant public health responses. In addition to a comprehensive and multi-sectorial overdose surveillance system, innovative data sources are needed to provide additional perspectives of small-area shifts in overdose mortality and to guide efforts to prevent drug overdose deaths.

Chapter 4: Economic Evaluation of Universal Hepatitis B Vaccination among Adults

Abstract

Background: After years of steady decline, incidence of acute infection with hepatitis B virus (HBV) has stabilized and may be increasing among adults greater than 30 years of age. Vaccination is the most effective way to protect against HBV infection in all age groups, but is currently only recommended for medically-stable infants and adults at high-risk of HBV infection. Vaccination coverage among adults born before 1991 remains low, even among adults at high-risk of infection. We aimed to evaluate the cost-effectiveness of a universal HBV vaccination recommendation among all adults.

Methods: We used a decision analytic tree with a Markov disease progression model to compare current vaccination recommendations and coverage (baseline strategy) with a universal HBV vaccination recommendation for the general population (intervention strategy). We modeled 1,000,000 microsimulation trials representative of the 2017 United States adult population and quantified costs (2019 U.S. dollars) from a societal perspective and benefits (quality-adjusted life years, QALYs) for each strategy. The strategies were compared using incremental cost-effectiveness ratios (ICERs), cost per infection averted, and the cost per HBV-related death averted. The base case scenario was defined as 50% vaccination coverage among the general population without any additional vaccination among high-risk persons. We defined several additional vaccination coverage scenarios and conducted sensitivity analyses (deterministic and probabilistic) on model inputs.

Results: In all scenarios, the intervention strategy resulted in an increase in costs and QALYs compared to the baseline strategy. In the base case coverage scenario, the intervention increased

costs by $129.51 and QALYS by 0.0006 per person (ICER=201,780) and averted 23.0% of acute HBV infections and 22.7% of HBV-related deaths. Across all probabilistic sensitivity analysis (PSA) runs, the median ICER was 140,525 (95% interval: 67,570 to 301,316). Scaling PSA results to the 2017 U.S. population, the intervention strategy averted 153,526 (95%CI: 75,220 to 275,616) acute HBV infections and 29,863 (95% CI: 14,869 to 58,195) premature deaths due to HBV among the non-high risk general U.S. adult population. Resulting ICERs were lower in scenarios with higher levels of vaccination coverage among the general population (70% coverage ICER=169,998) or additional vaccination among the high-risk population (80% coverage among high-risk persons ICER=139,870).

Conclusion: Recommending universal adult vaccination against HBV may be an appropriate strategy for reducing new HBV infections and improving health outcomes.

Publication

A full report of this study was reviewed and approved by the Advisory Committee on Immunization Practices (ACIP) economics technical review team.[160] The study was presented to the ACIP Hepatitis Vaccines Work Group on May 20th, 2020. This will also be submitted as a scientific manuscript to TBD.

Introduction

In the United States, an estimated 850,000 people are chronically infected with hepatitis B virus (HBV)[35], a major cause of liver disease and mortality. After steadily declining from 1990 to 2014, acute HBV incidence rates have remained stable in recent years, with an estimated 22,200 new cases occurring in 2017 alone.[1] Vaccination is an effective way to protect against HBV infection for all age groups. The 3-dose vaccine (HepB) series can protect 95% of healthy infants[52] and >90% of healthy adults <40 years of age.[53] In 1991, the vaccination of infants was first recommended in a national comprehensive HBV prevention strategy.[8,9,161] The most updated version of this strategy recommends universal vaccination of all medically-stable infants and vaccination of adults deemed at high-risk for HBV infection or at high-risk of developing health complications as a result of HBV infection. According to the Advisory Committee on Immunization Practices (ACIP) recommendations, adults indicated for vaccination include: 1) sex partners of hepatitis B surface antigen (HBsAg)-positive persons; 2) sexually active persons who are not in a long-term, mutually monogamous relationship; 3) persons seeking evaluation or treatment for a sexually transmitted infection; 4) men who have sex with men; 5) current or recent injection-drug users; 6) household contacts of HBsAg-positive persons; 7) residents and staff of facilities for developmentally disabled persons; 8) health care and public safety personnel; 9) hemodialysis patients; 10) persons with diabetes aged 19-59 years; 11) international travelers to countries with high prevalence (≥2%); 12) persons with hepatitis C virus infection; 13) persons with chronic liver disease; 14) persons with HIV and 15) incarcerated persons.[56,58]

Although the majority of people born after 1991 did receive the HepB vaccine as an infant, current vaccination coverage among adults born before 1991 remains quite low, especially among several of the groups recommended for adult vaccination.[9] In 2016, less than 25% of adults over 29 reported being vaccinated against HBV[61], which is particularly concerning considering this age group is experiencing an increase in acute HBV incidence as a result of increases in injection drug behaviors.[1,81] The importance of adult vaccination against HBV is not widespread knowledge and the list of groups deemed at-risk for HBV infection (and indicated for vaccination) is long and likely misinterpreted. Additionally, keeping a systematic record of vaccination among adults is not prioritized and is difficult to track.[84] A simplification of the recommendation and messaging associated with vaccination against HBV could lead to much larger uptake and have a significant impact on transmission. In this paper, we aimed to evaluate the cost-effectiveness of a recommendation of universal HBV vaccination among all adults.

Methods

Study Population and Strategies

We used a decision tree framework with a microsimulation Markov model to compare HepB vaccination strategies among a cohort of 1,000,000 trials representative of the 2017 U.S. adult population. Age heterogeneity was modeled using the single-year age distribution of adults between 19 and 100 years of age from the U.S. Census 2017 Intercensal Estimates.[162] The baseline strategy represented current levels of vaccination coverage among all adults in the United States (Table 3). Considering existing vaccination recommendations, vaccination coverage and risk of infection all differ by risk status, we explicitly modeled two groups: persons at high-risk of infection and the general population (i.e. non-high risk of infection). In the baseline strategy, only high-risk adults were indicated for vaccination and recommended to receive three doses of HepB vaccine.[56]

Table 3. Vaccine efficacy and vaccine coverage inputs for baseline strategy in cost-utility analysis of universal adult hepatitis B vaccination, United States

Input	**Base Case**	**Lower**	**Upper**	**Reference**
Proportion of population that is high risk	0.300	0.150	0.450	[163]
Active CHB prevalence (non-high risk)				
19-49 years	0.0034	0.0025	0.0047	[164]
50+ years	0.0039	0.0027	0.0056	[164]
Active CHB prevalence (high risk)	0.030	0.010	0.050	[165]
Proportion aware of CHB infection	0.339	0.167	0.511	[34]
Current vaccination coverage (non-high risk)				
19-29 years	0.921	0.700	0.990	[166]
30-39 years	0.000	0.000	0.200	Assumption
40-49 years	0.000	0.000	0.200	Assumption
50-59 years	0.000	0.000	0.200	Assumption
60+ years	0.000	0.000	0.200	Assumption
Current vaccination coverage (high risk)				
19-29 years	0.921	0.700	0.990	[166]
30-39 years	0.329	0.100	0.500	[61]
40-49 years	0.329	0.100	0.500	[61]
50-59 years	0.159	0.100	0.350	[61]
60+ years	0.159	0.100	0.350	[61]
Proportion that forget about vaccination				
19-49 years	0.300	0.236	0.364	[167]
50+ years	0.192	0.138	0.245	[167]
Proportion that receive dose 2, given dose 1				
19-29 years	0.819	0.819	0.819	Calculated
30-39 years	0.819	0.819	0.819	[168]
40-49 years	0.819	0.819	0.819	[168]
50-59 years	0.716	0.716	0.716	[163]
60+ years	0.739	0.739	0.739	[163]
Proportion that receive dose 3, given dose 2				
19-29 years	0.800	0.800	0.800	Calculated
30-39 years	0.800	0.800	0.800	[168]
40-49 years	0.800	0.800	0.800	[168]
50-59 years	0.545	0.545	0.545	[163]
60+ years	0.572	0.572	0.572	[163]
Efficacy of 1 dose only	0.308	0.200	0.400	[169]
Efficacy of 2 doses only	0.782	0.700	0.800	[169]
Efficacy of 3 doses (<50 years)	0.985	0.750	1.000	[169]
Efficacy of 3 doses (50+ years)	0.840	0.750	1.000	[170]

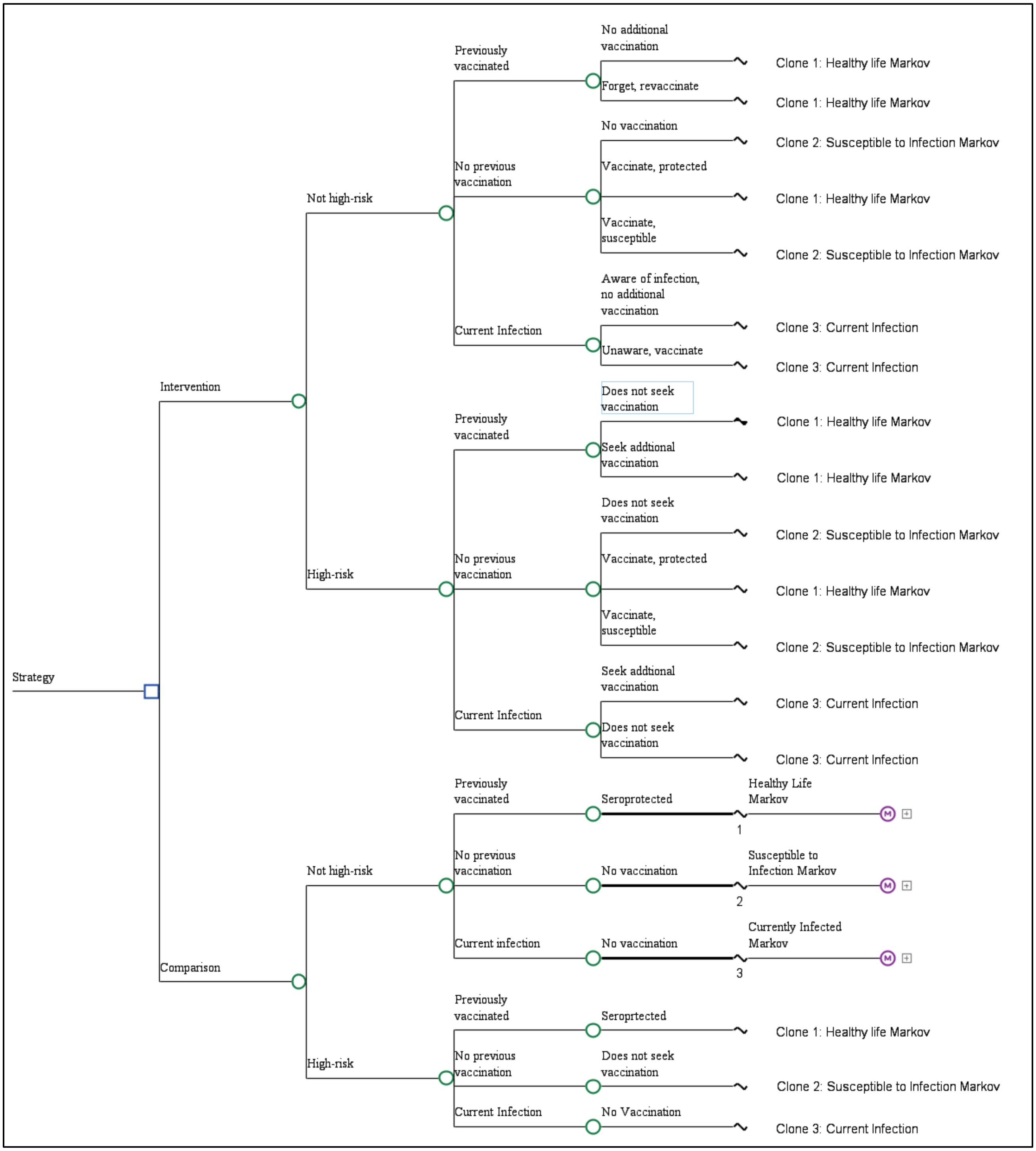
Abbreviations: CHB, chronic hepatitis B

The intervention strategy was a universal HepB vaccination recommendation among all adults that was assumed to be implemented in addition to the current existing recommendations. Therefore, current levels of prevaccination screening and testing (PVST) followed by subsequent vaccination of high-risk adults were assumed to remain in place and were represented equally in both the baseline and intervention strategies. In the base case scenario, the intervention strategy modeled 50% HepB vaccination series initiation among non-high-risk adults and assumed vaccination coverage among high-risk persons remained the same as the baseline strategy. In sensitivity analyses (described below), we relaxed these assumptions and defined additional scenarios in which we varied vaccination coverage among non-high-risk adults and allowed for the additional vaccination of high-risk adults in the intervention strategy. Since the intervention strategy did not include PVST for non-high risk persons, we modeled the unnecessary revaccination of non-high risk persons that forgot they were previously vaccinated at birth[167] and the unnecessary vaccination of persons with a current chronic HBV infection who are unaware of the infection.[35,165] Vaccination dropout between doses was based on data from a cohort study of adult vaccination completion rates.[163,168] The time frame for the intervention was one year.

Analytic Model and Primary Outcomes

We analyzed the costs and outcomes of both strategies using a decision-tree model (Figure 14) with a Markov disease progression model (Appendix C1, Supplemental Figure 2) in TreeAge Pro 2019.[171] The decision tree modeled individuals as either being at high-risk of infection or the general population (i.e. non-high risk for infection). To represent the historical trajectory of hepatitis B infection and vaccination, each individual trial was initially determined to be previously vaccinated, chronically infected or susceptible. Next, we modeled additional vaccination determined by the coverage level in the intervention strategy. Vaccine coverage and vaccine efficacy estimates differed by starting age and were applied according to the following age groups: 19-29 years, 30-39 years, 40-49 years, 50-59 years and 60+ years old. All individual trials resulted in either being currently infected, having vaccine-induced protection (anti-HBs $\geq$ 10mIU/mL) against HBV infection or not protected (mutually exclusive). In the intervention strategy, all vaccine doses and resulting protection were assumed to occur at a single point in time.

Figure 14. Decision tree model used for cost-utility analysis of universal adult hepatitis B vaccination, United States



Note: Terminal nodes represent 3 mutually exclusive outcomes: protected (Health life Markov), currently infected, or susceptible to infection. Decisions are indicated by squares and chance outcomes by circles.

Trials that were protected against infection entered a “Healthy Life” Markov process in which they were not at risk of acquiring an HBV infection and experienced an age-specific annual probability of death defined by the National Vital Statistics System (NVSS) 2015 U.S. Life Tables[172] (i.e. background mortality). All trials that were not seroprotected entered the “Susceptible to Infection” Markov process, which was adapted from a previously published model[173] and is described in detail in Appendix C1. Briefly, all trials started in a “Susceptible” health state and remained in that state until death or an incident acute HBV infection occurred. Trials that became infected then passed through a series of health states that represented acute and chronic HBV infection, immune system phases, potential treatment, and resulting advanced liver disease. Individuals who had a prevalent chronic HBV infection at the beginning of the model started the disease progression process in an active infection health state.

The time step for the Markov processes was one year, and individual trials accumulated costs and quality-adjusted life years (QALYs) for every time step spent in each health state. Background mortality was consistent across strategies, meaning trials that did not become infected accumulated the same number of QALYs in each strategy. The analytic horizon was the lifetime of the cohort and we summed costs, QALYs and life-years over the lifetime of each trial to determine the average cost and average QALYs per trial for each strategy. Incremental cost-effectiveness ratios (ICERs) were calculated by dividing the difference in average cost by the difference in average QALYs. The number needed to vaccinate to prevent one acute HBV infection (NNV) was calculated by dividing the difference in number of persons vaccinated and protected against infection by the difference in total number of acute infections between the two strategies.[174] The cost per acute HBV infection averted and cost per HBV-related death averted were calculated by dividing the difference in total cost by the difference in total acute HBV infections and HBV-related deaths, respectively.

Model Inputs

Data for current vaccine coverage differed by age group and was from large, national surveys. Data from the 2016 National Health Interview Survey (NHIS) indicated 32.9% of adults aged 30-49 years and 15.9% of adults aged 50 years or older had received three doses of HepB vaccine[61] (Table 3). Considering only adults >30 years and at high-risk of infection are recommended for vaccination[56], these coverage estimates were applied to the high-risk group, and coverage among adults >30 years in the non-high risk group was assumed to be 0%. As a result of the 1991 recommendation to provide HepB vaccination for all infants, coverage among adults younger than 30 years in 2018 was much higher than older adults. However, NHIS data is not a reliable estimate for this age group because the survey is based on participant recall, and adults younger than 30 years may not be able to accurately remember vaccinations they received as an infant. To account for this, we used data from the National Immunization Survey (NIS) for current vaccine coverage among adults 19-29 years. NIS is a telephone survey that involves interviews with parents or guardians and a questionnaire that is mailed to vaccine providers. Data from the 2013 NIS indicated 92.1% of 17 year olds had received three doses of HepB vaccine in 2018.[175] Considering this coverage estimate from 2013 reflected individuals who would have been 23 years old in 2019, we used this estimate for vaccination coverage for adults 19-29 years of age in our model.

The intervention strategy did not include prevaccination screening and testing for non-high risk persons, so the strategy was expected to result in the unnecessary vaccination of some previously vaccinated persons and currently infected persons. Therefore, previously vaccinated persons who forgot they are vaccinated (30% of adults <50 years and 19.2% of adults 50+ years)[167] and currently infected persons who are unaware of their infection (66.1% of persons with chronic HBV infection)[34] also initiated a vaccination series in the intervention strategy. To model dropout between vaccination doses for adults aged 30-49 years, we used data from a 2009 cohort study on HepB vaccine schedule compliance among adults that received at least one dose.[168] Data on HepB vaccine series completion for adults 50+ years of age were from an additional cohort analysis of vaccine compliance among older adults.[163]

All vaccine efficacy inputs were assumed to mirror the vaccine efficacy of Engerix-B/TWINRIX[169]. Efficacy of one dose only (30.8%) and two doses only (78.2%) was assumed to be the same for all ages.[169] Vaccine efficacy of a full three dose series differed for individuals under 50 years of age (84.0%) and individuals 50 years or older (98.5%).[169,170] As commonly done in HepB vaccination analyses, we assumed vaccine-induced protection did not wane over time. Protection has been shown to last for at least three decades, regardless of waning anti-HBs levels.[176,177]

The risk of acute HBV infection differed by risk group and age group and represented the risk of acquiring HBV infection among unvaccinated, uninfected U.S. adults. To estimate the risk of infection parameter, we adjusted the reported 2017 HBV incidence from the Division of Viral Hepatitis (CDC)[1] to account for underreporting of new HBV cases[19], current acute HBV prevalence[35] and current levels of HepB vaccination coverage.[61,175] A full description of the inputs and formulas used for these calculations is included in Appendix C2.

Cost and Utility Inputs

We used a societal perspective that included all direct and indirect costs related to HepB vaccination, HBV infection and resulting sequelae in 2019 U.S. Dollars. The public and private prices for a HepB vaccine (Engerix-B) were obtained from the CDC Vaccine Price List 2019.[178] In the base case analysis, we used the private price for the cost of each vaccine dose ($58.95), and the lower and upper bounds for cost of vaccine dose were a 25% decrease or 25% increase in the private price, respectively (Table 4). Cost of vaccine administration is from previously published data that found the mean reimbursement for routine vaccine administration was $25.80 in 2016.[179] This was adjusted to 2019 USD using the 2019 Medical Consumer Price Index (CPI).[180] The cost of time for receiving one dose was calculated by multiplying the average hourly wages from all nonfarm workers ($27.55) by three hours of work.[181]

Table 4. Cost and utility inputs in cost-utility analysis of universal adult hepatitis B vaccination, United States

Input	**Base Case**	**Lower**	**Upper**	**Reference**
Vaccination Costs (2019 USD)				
One dose of HepB (Engerix-B)	58.95	44.21 (-25%)	73.69 (+25%)	178
Administration of one dose of HepB	27.85	20.89 (-25%)	34.81 (+25%)	179,180
Hepatitis B surface antibody test	10.74	8.06 (-25%)	13.43 (+25%)	182
Hepatitis B core antibody total test	12.05	9.04 (-25%)	15.06 (+25%)	182
Hepatitis B surface antigen test	10.33	7.75 (-25%)	12.91 (+25%)	182
Time for receiving one dose of HepB	82.65	61.99 (-25%)	103.31 (+25%)	181
Travel to receive one dose of HepB	20.00	10.00 (-50%)	30.00 (+50%)	Assumption
Annual Health State Costs (2019 USD)				
Acute Hepatitis, asymptomatic	0.00	0.00	671.34	173,180
Acute Hepatitis, symptomatic	385.32	199.68	671.34	173,180
Fulminant Hepatitis*	18,739.30	18,682.10	50,176.90	173,180
HBeAg+, Active CHB, Non-Cirrhotic	1,395.57	698.33	4,187.79	173,180
HBeAg+, Active CHB, Cirrhotic	2,929.30	1,464.65	8,786.81	173,180
HBeAg-, Active CHB, Non-Cirrhotic	1,395.57	698.33	4,187.79	173,180
HBeAg-, Active CHB, Cirrhotic	2,929.30	1,464.65	8,786.81	173,180
HBeAg-, Inactive CHB, Non-Cirrhotic	698.33	348.62	2,093.90	173,180
HBeAg-, Inactive CHB, Cirrhotic	1,464.65	731.78	4,392.87	173,180
Decompensated Cirrhosis	34,683.14	32,551.47	36,816.97	173,180
Hepatocellular Carcinoma	55,324.22	49,651.27	60,989.61	173,180
Liver Transplant*	219,631.47	202,537.06	236,721.55	173,180
Post Liver Transplant	47,833.68	39,085.72	56,581.64	173,180
Anti-HBs, Non-Cirrhotic	348.62	174.85	1,046.95	173,180
Anti-HBs, Cirrhotic	731.78	365.89	2,196.43	173,180

Initial tests and evaluations*	356.09	178.09	534.18	[173,180]
Annual Treatment Cost	9,576.00	5,988.00	11,976.00	[173]
Annual Cost of Monitoring Treatment Tests	690.89	345.54	1,036.00	[173]
Annual Cost of Adverse Events	732.00	366.00	1,098.00	[173]
Health State Utilities				
Susceptible	0.990	0.980	1.000	[173]
Immune	0.990	0.980	1.000	[173]
Acute HBV, asymptomatic	0.990	0.950	1.000	[173]
Acute HBV, symptomatic	0.700	0.630	0.770	[173]
Active CHB, Non-Cirrhotic	0.670	0.603	0.737	[173]
Active CHB, Cirrhotic	0.660	0.594	0.726	[173]
Inactive CHB, cirrhotic and non-cirrhotic	0.850	0.765	0.935	[173]
Fulminant Hepatitis	0.370	0.333	0.407	[173]
Decompensated Cirrhosis	0.370	0.333	0.407	[173]
Hepatocellular Carcinoma	0.430	0.387	0.473	[173]
Liver Transplant	0.570	0.513	0.627	[173]
Post Liver Transplant	0.640	0.576	0.704	[173]
Anti-HBs	0.860	0.774	0.946	[173]
Annual utility loss while on treatment	0.031	0.000	0.047	[173]

Abbreviations: HepB, hepatitis B vaccine
*Indicates one-time cost as a single episode

In both the baseline and intervention strategies, adults at high-risk of infection received prevaccination screening and testing (PVST) to determine previous vaccination or infection. A single PVST visit included costs associated with a hepatitis B surface antibody (anti-HBs) test, a hepatitis B core antibody (anti-HBc) test, a hepatitis B surface antigen (HBsAg) test, three hours of time and travel. All costs for PVST tests were from the Centers for Medicare and Medicaid Services 2020 Clinical Diagnostic Laboratory Fee.[182] High-risk individuals that were eligible to receive vaccination were assumed to receive the first dose of vaccine at the same visit as their PVST.

All annual health state costs related to the medical management of HBV infection and resulting sequelae were abstracted from a recently published model[173] and converted to 2019 U.S. Dollars using the Medical Care CPI[180] (Table 4). Although this model did not explicitly model all healthcare encounters individually, the incorporated costs included all estimated annual costs associated with the management of disease. The cost of initial tests and evaluations were included as a one-time cost that was applied to every trial with an incident chronic HBV infection. This included tests for hepatitis B e-antigen (HBeAg), hepatitis B e-antibody (anti-HBe), hepatitis B surface antibody (anti-HBs), hepatitis B core antibody (anti-HBc), hepatitis B DNA quantification, liver enzyme tests, complete blood count, hepatitis C virus, hepatitis D virus, human immunodeficiency virus, renal function panel and an ultrasound[173]. Individuals on treatment accrued an additional cost for regular annual testing to monitor treatment. The annual cost of treatment was calculated by multiplying the monthly cost of Tenofovir by 12 months and converted to 2019 USD using the 2019 Medical Care CPI.[173,180]. An additional cost for the medical management of treatment-related adverse events was applied annually to each individual on treatment.[173]

Effectiveness of each strategy was quantified using quality-adjusted life years (QALYs), a summary measure that incorporates both the quantity and quality of life.[183] To calculate QALYs, previously published utility weights were assigned to each health state[173] (Table 4). Utility weights were multiplied by the number of years each individual spent in the respective health state. In all analyses, the utility value for susceptible to infection and the utility value for immune to infection were assumed to be the same. All costs and utilities were discounted at 3% per year.

Sensitivity Analyses

We conducted three types of sensitivity analyses. First, one-way sensitivity analyses were conducted on each input to determine their potential individual impact on base case results. The individual inputs that had the largest effect on the resulting ICER were summarized in a tornado diagram. Similarly, we conducted sensitivity analyses in which all the inputs within a group of parameters (e.g. all health state utility values, reported incidence for all ages, etc.) were set to their extreme (either maximum or minimum) values concurrently.

Second, one-way and two-way interval sensitivity analyses were conducted on epidemiologic inputs of interest. For each of these sensitivity analyses, we specified values at intervals for the input of interest and ran the model with each value. For example, a one-way interval sensitivity analysis was conducted on the proportion of non-high risk adults that receive vaccination in the intervention strategy by setting the value of that input to 30%, 40%, 50%, 60% and 70% and outputting results for each model run. For these analyses, we assumed vaccine coverage in the intervention strategy did not drop below coverage in the baseline strategy for any of the age groups (e.g. vaccine coverage was still 91.3% for 19-29 year olds). Additionally, we conducted an interval sensitivity analysis in which a proportion of unvaccinated high-risk adults (0%, 20%, 40%, 60%, and 80%) also initiated vaccination in the intervention strategy as an indirect result of the policy change. As an extension of these two sensitivity analyses, we calculated results at varying levels of reported acute HBV incidence under both favorable and unfavorable vaccination coverage assumptions. We defined the favorable coverage scenario as the intervention strategy achieving vaccination coverage of 70% in the general population and resulting in 60% additional vaccination among high-risk persons. In contrast, the unfavorable coverage assumptions was defined as 30% coverage in the general population and no additional vaccination among high-risk persons.

Third, we conducted a probabilistic sensitivity analysis (PSA) to assess the combined stochastic uncertainty of all model inputs. A triangle distribution was defined for each input parameter, with the base case value set as the distribution mean and the upper and lower limits set as the upper and lower bounds of the distribution, respectively. We sampled 100 input parameter sets and ran 1,000,000 microsimulation Monte Carlo trials with each parameter set. For all model runs in the PSA, the intervention strategy was defined as vaccination coverage among non-high risk persons at 50%, with 0% additional vaccination among high-risk persons, and the cost of one dose of vaccine being $58.95 (i.e. same as the base case in deterministic analyses). For all outcomes of interest, we report the median result and the 95% interval (2.5th and 97.5th percentile) from the PSA results.

Results

Across all scenarios, the intervention strategy (i.e. universal vaccination) resulted in increased costs and increased QALYs compared to the baseline strategy. In the deterministic base case scenario, the intervention strategy increased costs by $129.51 and increased QALYS by 0.0006 per person (ICER=201,780, Table 5). Compared to the baseline strategy, the intervention strategy averted 23.0% of acute HBV infections and 22.7% of HBV-related deaths. In order to prevent one acute HBV infection, 368 persons needed to be vaccinated and protected against infection. Scaling these base case results to the 2017 U.S. population, the intervention strategy resulted in 52,422,157 additional persons with vaccine-induced protection, which averted 142,786 acute HBV infections and 19,578 premature deaths due to HBV among the non-high risk general U.S. adult population (Appendix C3, Supplemental Table 10).

Table 5. Deterministic base case results and summary of probabilistic sensitivity analysis results of cost-utility analysis of universal vaccination against HBV infection among adults, United States

	Probabilistic Sensitivity Analysis*			Base Case*
Outcome	**Median**	**5th**	**95th**	
USD per person (baseline strategy)	773.15	482.05	1237.66	670.12
USD per person (intervention strategy)	891.26	612.25	1356.39	799.63
Incremental USD per person	122.84	101.58	157.29	129.51
Incremental QALYs per person	0.00089	0.00042	0.00187	0.00064
ICER (USD/QALY)	140,525	67,570	301,316	201,780
Acute HBV infections averted	153,526	75,220	275,616	142,746
USD per acute HBV infection averted	215,371	99,714	391,524	224,847
NNV (acute infection)	326	170	566	368
HBV deaths averted	29,863	14,869	58,195	19,578
USD per HBV death averted	1,078,640	516,696	2,159,689	1,639,392
Life-years gained	438,274	199,293	897,793	276,322
USD per life-year gained	75,490	33,351	152,188	116,154

*All analyses compare current vaccination coverage to 50% vaccination coverage among the general population and no additional vaccination coverage among high-risk persons. All analyses assume the cost of one vaccine dose is $58.95. Abbreviations: HBV, hepatitis B virus; USD, 2019 U.S. Dollars; QALYs, quality-adjusted life years; ICER, incremental cost-effectiveness ratio; NNV, number needed to vaccinate to prevent an acute infection; %, percent.

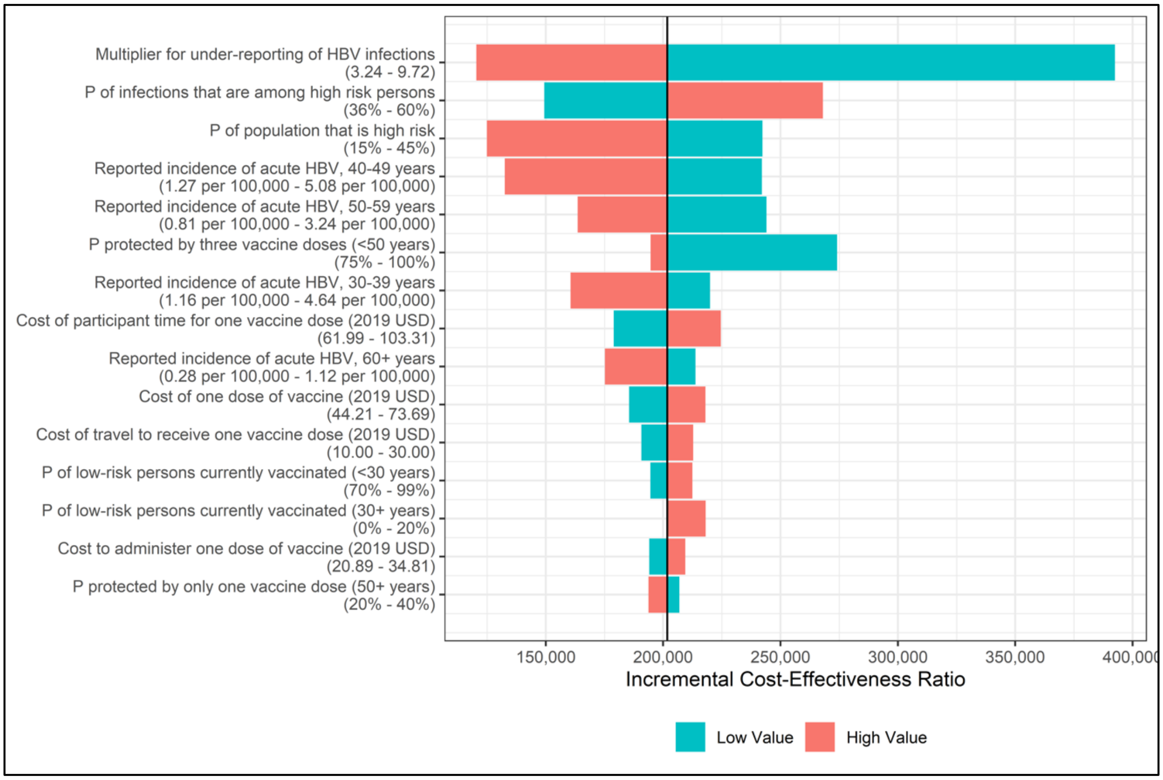
Results from the probabilistic sensitivity analysis on model inputs are displayed in Table 5. In all 100 parameter sets and resulting model runs, the intervention strategy resulted in an increased cost and QALYs per person compared to the baseline strategy (Appendix C3, Supplemental Figure 4). The median incremental cost per person ($122.84, 95% interval: 101.58, 157.29) was slightly lower and the median QALYs gained per person (0.00089, 95% interval: 0.00042, 0.00187) were slightly higher than the comparable values from the deterministic base case analysis. The resulting median ICER across all 100 PSA model runs was 140,525 (95% interval: 67,570 to 301,316, Table 5; Appendix C3, Supplemental Figure 5).

As vaccination coverage among the non-high risk population increased, the resulting incremental cost per person, QALYS gained and percent of infections and deaths averted all increased (Appendix C3, Supplemental Table 11). The resulting ICERs ranged from 169,998

(70% vaccination coverage) to 209,641 (30% vaccination coverage). Similarly, scenarios in which the policy change led to an increase in high-risk persons seeking vaccination also resulted in an increase of incremental costs and QALYS compared to the baseline strategy (Appendix C3, Supplemental Table 12). When 80% of high-risk persons sought vaccination as a result of the policy change, the resulting ICER was 139,870 (ICER=145,132 at 60%; 158,142 at 40%; 169,713 at 20%).

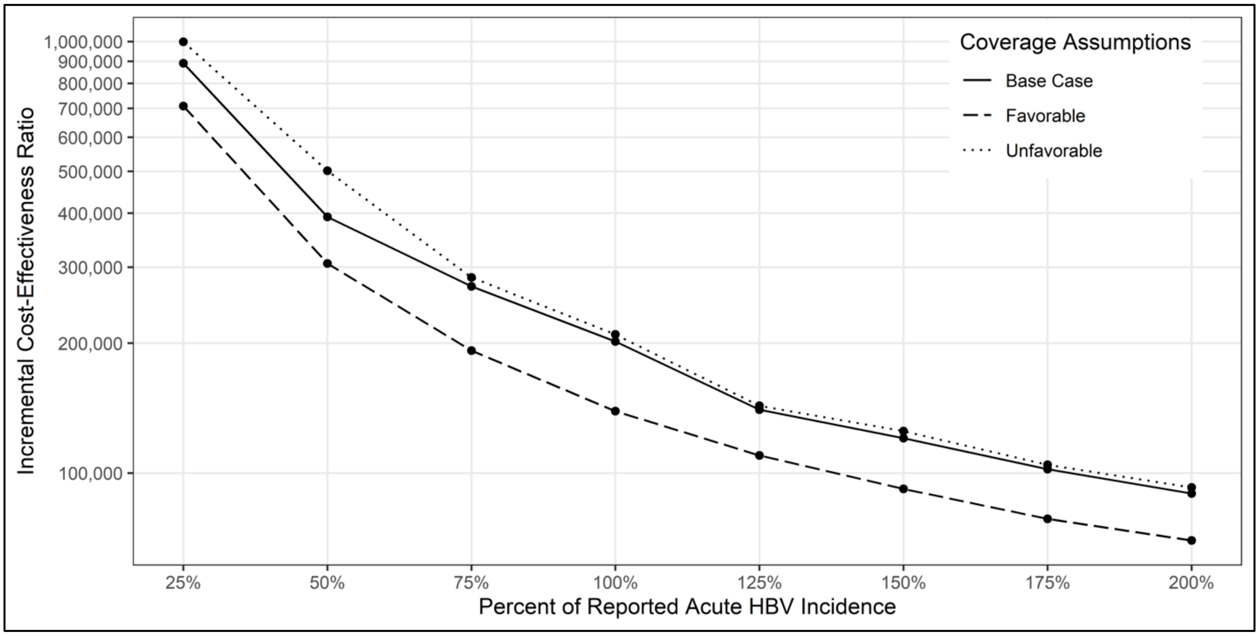
A tornado diagram of the inputs whose uncertainty had the largest effect on the resulting ICER is presented in Figure 15. The inputs with the biggest impact on the resulting ICER were: the under-reporting multiplier used in calculating risk of infection, the proportion of infections that occur among high-risk persons, the proportion of population that is high risk, and the reported incidence of acute HBV among adults 40-49 years of age. The group of inputs whose uncertainty had the largest impact on the resulting ICER was the reported acute HBV incidence estimate for each age group (Appendix C3, Supplemental Figures 6-7). Figure 16 presents resulting ICERs of the favorable and unfavorable vaccination settings across a range of reported acute HBV incidence values.

Figure 15. Tornado diagram of most influential inputs in a cost-utility analysis of universal adult hepatitis B vaccination, United States



Abbreviations: HBV, hepatitis B virus; P, percent; USD, 2019 U.S. Dollars.

Figure 16. Incremental cost-effectiveness ratios at varying estimates of acute HBV incidence in a cost-utility analysis of universal adult hepatitis B vaccination, United States*



Abbreviations: HBV, hepatitis B virus.
*Base case vaccination coverage scenarios assume 50% coverage in the general population and no additional vaccination among high-risk persons. The favorable scenarios assume 70% vaccination coverage among the general population and 60% additional vaccination among high-risk persons. Unfavorable coverage scenarios assume 30% vaccination among the general population and no additional vaccination among high-risk persons. Reported acute HBV incidence values are: 0.60 per 100,000 (19-29 years old); 2.32 per 100,000 (30-39 years old); 2.54 per 100,000 (40-49 years old); 1.62 per 100,000 (50-59 years old); 0.56 per 100,000 (60+ years old).

Discussion

The findings from this analysis indicate a universal adult HepB vaccination strategy results in additional costs and additional QALYs compared to the baseline (current) vaccination strategy. These results hold true across a range of scenarios in which vaccination coverage among the general population in the intervention strategy is between 30% and 70%. Higher vaccination coverage in the intervention strategies resulted in better health outcomes -- the average QALYs gained, life-years gained, number of acute HBV infections averted and number of HBV-related deaths averted all increased as vaccination coverage in the intervention strategy increased. The base case comparison and several of the sensitivity analyses valued the cost per

QALY gained by the intervention (universal vaccination) strategy around $200,000, indicating the results are robust against the influence of any single model assumption or input. When all inputs were varied concurrently in the probabilistic sensitivity analysis, the majority (51%) of parameter sets favored the intervention strategy at a willingness-to-pay value of $141,000/QALY, with almost a quarter of parameter sets favoring the intervention strategy at $100,000/QALY. Notably, the incremental cost per person across the different PSA model runs did not vary greatly. In general, results were most sensitive to the inputs that are used to estimate the risk of infection (reported acute HBV incidence, under-reporting multiplier, the proportion of reported infections that occur among high-risk persons). As expected, the cost-effectiveness of the intervention strategy improved when combinations of these inputs resulted in scenarios with increased risks of infection. Although the uncertainty of all of these inputs were collectively included in the probabilistic sensitivity analysis, the additional one-way and two-way sensitivity analyses around these inputs helped isolate their influence on results.

The primary analysis focused on recommending vaccination for the general adult population. Considering vaccination is already recommended for high-risk adults, the primary analysis included a conservative base case assumption that vaccination coverage among high-risk persons would not change. However, the actual implementation of a universal adult vaccination recommendation would likely result in an increase in vaccination among high-risk persons, in addition to the intended effects among the general population. As expected, scenarios in which vaccination coverage increased among high-risk adults were more favorable (i.e. had lower ICERs) compared to the base case assumptions.

These results support a need to quantify and increase communication of the economic value of adult vaccinations.[184] ACIP already recommends the vaccination of infants at birth and any unvaccinated persons <19 years of age.[56] Previous economic analyses of hepatitis B vaccination among adults has focused on providing vaccination to specific populations (e.g. adults with diabetes[185], injection drug users[173,186], homeless persons) or in specific settings (e.g. clinics for sexually transmitted infections[187], HIV testing sites[188]). To our knowledge, this is the only economic analysis investigating the cost-effectiveness of recommending vaccination for all adults, but the framework and outcomes used in this analysis are common in economic evaluations of adult vaccination. A systematic review of adult vaccination economic analyses found the most common outcome for assessing cost-effectiveness is cost per QALY.[184] This analysis differs from the hepatitis B studies included in that review because all of the included studies focused only on indication-based recommendations. The results from this analysis support the authors' conclusion to increase implementation of adult vaccination recommendations.

Recent trends in HBV incidence further highlight the importance of hepatitis B vaccination among adults. From 2011 to 2016, estimated national acute HBV incidence increased 11%[1], with much larger increases reported in specific states in Appalachia (i.e. Kentucky, Tennessee and West Virginia).[79] These increases in acute HBV incidence are primarily seen among whites, aged 30-39 years old who reported injection drug use. Increase in infectious transmission is likely being driven by increase in injection drug use as a result of the opioid epidemic.[69,80,81] Considering hepatitis B vaccination coverage is low among the general population, it is likely to also be low among injection drug users under current recommendations.

Limitations

This approach and analysis has a few limitations. First, the epidemiologic model is a static model that assumes risk of infection does not change over time. Given the intervention being considered represents a single point in time vaccination strategy, the analytic horizon is the lifetime of the cohort, and the intervention strategy projects to be cost-effective, a static model is a justifiable approach.[189] Compared to a dynamic epidemiological model, this approach results in a conservative estimate of benefits because it does not include indirect effects (e.g. herd immunity) that would result in indirect protection of persons that never seek or complete vaccination. Second, while we did model dropout between vaccination doses and incorporated dose-specific efficacy estimates, we assumed all vaccination occurs at a single point in time and once protection is achieved, it does not wane. Although implementation considerations were not part of this analysis, programmatic practicalities would likely require a universal vaccination campaign to be administered over multiple years. Third, we explicitly modeled a group at high-risk of infection and non-high risk infection but we assumed homogeneity of risk by age within in each group and assumed risk group status did not change for the duration of the individual's life. Fourth, the adapted model of hepatitis B disease progression does not include co-infections with HIV, hepatitis C or other infections, which could alter quality (and length) of life, progression of hepatitis B infection and associated medical costs.[173] Considering HCV or HIV infection is associated with injection drug use[76,81], a major risk factor for HBV infection, co-infections may play an important role in the HBV epidemic. Finally, this study only looks at vaccination strategies in the absence of additional screening or linkage to care programs. Although we included current recommendations to include prevaccination screening and testing among high-risk persons, we did not model any screening among the general population. In reality, an increase in vaccination efforts would likely be rolled out with other interventions to reduce the disease burden. Similarly, we focused only on the recommendation of universal vaccination and did not model implementation costs of a universal vaccination program. As vaccination coverage increased, it would likely become more costly to identify and vaccinate the remaining susceptible adults.

Conclusion

Universal adult vaccination against hepatitis B may be an appropriate strategy for reducing HBV incidence and improving resulting health outcomes. In May 2020, these results were presented to the ACIP working group within the Division of Viral Hepatitis. This analysis will be incorporated into ACIP deliberations on updating hepatitis B vaccination guidelines.

Chapter 5: Conclusions and Public Health Implications

This dissertation provides timely contributions to a current public health priority, the elimination of viral hepatitis. In this dissertation, I have focused on producing new data that can be used to better understand the current viral hepatitis epidemic, assess the impact of potential intervention and monitor progress. Through this work, this dissertation has advanced both epidemiologic research and public health practice. In Chapter 5, I summarize the major findings from the dissertation, highlight the innovation, describe public health impact and discuss future research directions.

Review of Major Findings

In Chapters 2 and 3, I focused on describing and understanding the viral hepatitis epidemic on a granular county-level. Findings from Chapter 2 demonstrate that there has been a shift in HCV mortality trends since 2013, but that shift has occurred differently across the country. National HCV death rates have been decreasing since 2013, and these county-level results indicate that national trend is primarily being driven by decreasing HCV mortality in a few key regions (the West, Southwest and Northeast). Although this analysis did not investigate causes of these trends, decreasing county-level HCV death rates are likely a result of both improvements in public health interventions (e.g. screening, treatment) and changing of population demographics (i.e. aging of the high burden cohort). Of public health concern is the result that HCV mortality increased in 20% of U.S. counties from 2013-2017, many of which were concentrated in Texas, Oklahoma and Appalachia. Many of the areas that experienced increases in overall HCV mortality since 2013 also had the highest HCV deaths among persons <40 years of age in 2017. Considering injection drug use is the primary risk factor for HCV infection among adults <40 years[1], these results further highlight areas that have been impacted by injection drug use.

Recognizing the established links between the opioid epidemic, injection drug use and increased infectious disease transmission, Chapter 3 provided a framework to better understand how the opioid epidemic has been impacted by county-level characteristics. The findings from Chapter 3 demonstrated there has been an inverse relationship between opioid prescribing rates and drug overdose mortality that differs by geography and county-level characteristics. In 2006, the number of overdose deaths per 100,000 opioid prescriptions ranged from 11.8 (poverty 1) to 18.3 (low education) across county-type classes. By 2017, the same range had increased and widened, ranging from 19.9 (poverty 1) to 42.0 (high education). As opioid prescribing rates decreased, overdose deaths generally increased, but that trend has been slower in areas of high poverty or counties dependent on farming and mining.

Chapter 4 transitioned to a population-level perspective to assess the economic impact of a policy intervention and found that a recommendation for universal adult vaccination against HBV could be an effective strategy in reducing new HBV infections and resulting health complications. In all scenarios, the intervention strategy was more costly but resulted in better health outcomes than the baseline strategy. Under conservative base case vaccination coverage assumptions (50% coverage among the general adult population with no additional coverage among high-risk persons), deterministic model results found the intervention strategy averted roughly a quarter of new HBV infections and HBV-related deaths and would be cost-effective at a willingness-to-pay threshold of $201,780 per QALY (PSA ICER=140,525, 95%CI: 67,570 to 301,316). Relative to the base case coverage assumptions, the intervention strategy was more favorable in scenarios in which risk of infection was higher or vaccination coverage increased among either the general population (70% coverage ICER=169,998) or the high-risk population (80% coverage among high-risk persons ICER=139,870).

Innovation

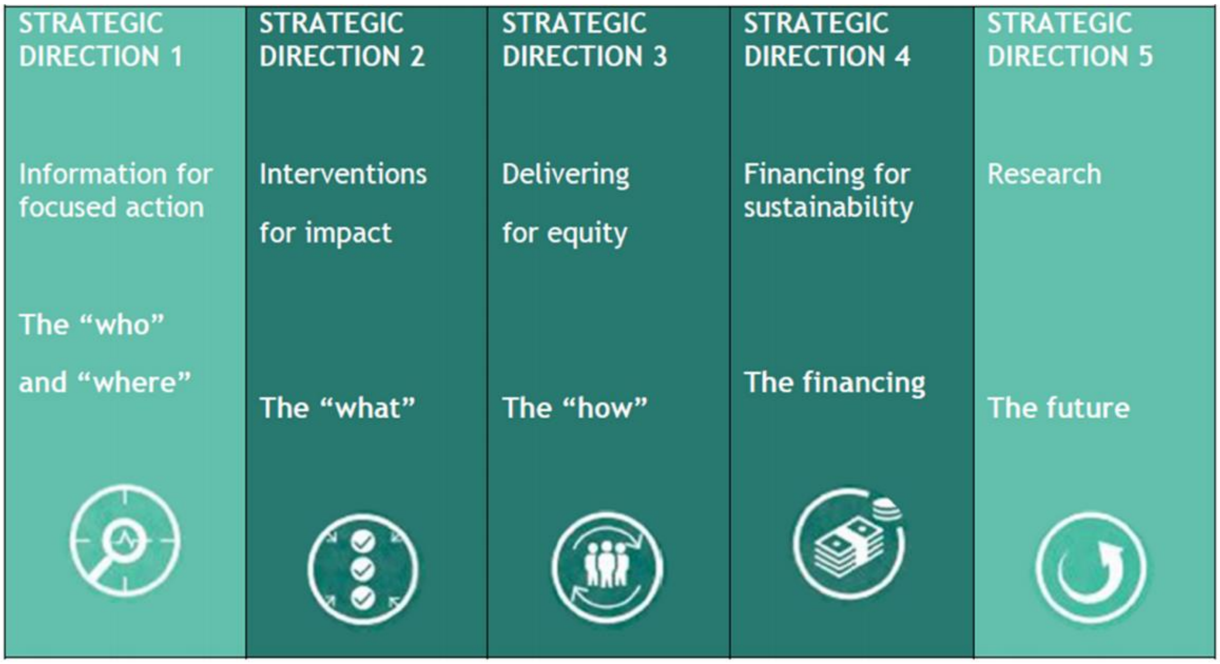
Across all three studies, this dissertation included innovation through the application of analytic methods that had not been used in the viral hepatitis literature, the generation of small-area new data and the formation of novel research questions with direct public health impact. Prior to this work, HCV mortality had not been systematically summarized on a local level.[33,40,190,191] Although HCV mortality is more common than deaths attributable to other infectious diseases, it is less common than deaths attributable to more common chronic conditions (e.g. heart disease, cancer) or unintentional injury.[192] In order to estimate reliable annual county-level rates, we drew from literature on spatial-temporal modeling of count outcomes that had previously only been applied to heart disease outcomes[99,105,106] and stroke mortality.[98,193] This family of Bayesian spatiotemporal models leverages data across demographic groups, time and place to result in precise small-area estimates even when observed case counts are low.[107] In the stroke and heart disease literature, researchers have used these models to estimate county-level death rates stratified by various demographic groups (e.g. race, sex and age). Although there is insufficient data to reliably estimate similar stratified rates for HCV mortality, we specified models that were well suited to estimate overall or one-way stratified county-level HCV deaths rates, resulting in the availability of a key county-level epidemiologic indicator.

In addition to estimating a core epidemiologic indicator in Chapter 2, we developed and demonstrated a novel approach for levering additional county-level data in Chapter 3. An understanding of the complex relationships between the opioid epidemic, injection drug use and drug overdose mortality has important implications on public health strategies and interventions that aim to reduce mortality or infectious disease transmission. However, each of these constructs is extremely difficult to measure and regularly changing. In the absence of comprehensive drug use surveillance systems, innovative uses of existing data are needed to explore these relationships. Chapter 3 of this dissertation presents an innovative metric that summarizes the relationship between opioid availability and overdose mortality. Although the metric is not without limitations, it is relatively simple to interpret and can be assessed longitudinally on small-areas (e.g. county-level) using publicly available data. In the discussion of the utility of the metric, we presented a framework for using it as an outcome to answer additional questions about county-level impact. Furthermore, we demonstrated use of this metric by analyzing temporal changes by characteristics of place. By using a social ecological model[140,194], we identified large amounts of data and county-level factors that impact this relationship. Considering the exploratory nature of the LPA process, we developed a grouping of county-type classes that was grounded in theory.

Relevance and Public Health Impact

This dissertation provides results that influence the direction for future research and have implications for public health policy. The aims of this dissertation were designed within the context of existing priorities established by viral hepatitis elimination efforts in the public health community. In 2016, the World Health Organization outlined five strategic directions to guide countries in their formation of national viral hepatitis elimination strategies and in 2017 NASEM used those directions to organize priorities specific to the United States (Figure 17).[82,83] Within the five strategic directions, a multidisciplinary NASEM committee published a list of recommendations that need to be prioritized to achieve the elimination of HCV and HBV in the United States (Table 6).[83]

Figure 17. Strategic directions from a national strategy for the elimination of hepatitis B and C, National Academies of Science, Engineering and Medicine



Citation: National Academies of Science, Engineering and Medicine[83,84]

Table 6. Recommendations from the National Academies of Science, Engineering and Medicine National Strategy for the Elimination of HCV and HBV

Number	Recommendation
2-1	The highest level of the federal government should oversee a coordinated effort to manage viral hepatitis elimination.
Public Health Information	
3-1	The Centers for Disease Control and Prevention (CDC), in partnership with state and local health departments, should support standard hepatitis case finding measures and the follow-up and monitoring of all viral hepatitis cases reported through public health surveillance. CDC should work with the National Cancer Institute to attach viral etiology to reports of liver cancer in its periodic national reports on cancer.
3-2	The Centers for Disease Control and Prevention should support cross-sectional and cohort studies to measure HBV and HCV infection incidence and prevalence in high-risk populations
Essential Interventions	
4-1	States should expand access to adult hepatitis B vaccination, removing barriers to free immunization in pharmacies and other easily accessible settings.
4-2	The Centers for Disease Control and Prevention, the American Association for the Study of Liver Diseases, the Infectious Diseases Society of America, and the American College

of Obstetricians and Gynecologists should recommend that all HBsAg+ pregnant women have early prenatal HBV DNA and liver enzyme tests to evaluate whether antiviral therapy is indicated for prophylaxis to eliminate mother-to-child transmission or treatment of chronic active hepatitis.

4-3 States and federal agencies should expand access to syringe exchange and opioid agonist therapy in accessible venues.

4-4 The Centers for Disease Control and Prevention should work with states to identify settings appropriate for enhanced viral hepatitis testing based on expected prevalence.

4-5 Public and private health plans should remove restrictions that are not medically indicated and offer direct-acting antivirals to all chronic hepatitis C patients.

Service Delivery

5-1 The National Committee for Quality Assurance should establish measures to monitor compliance with viral hepatitis screening guidelines and hepatitis B vaccine birth dose coverage and include the new measures in the Healthcare Effectiveness Data and Information Set.

5-2 The American Association for the Study of Liver Diseases and the Infectious Diseases Society of America should partner with primary care providers and their professional organizations to build capacity to treat hepatitis B and C in primary care. The program should set up referral systems for medically complex patients.

5-3 The Department of Health and Human Services should work with states to build a comprehensive system of care and support for special populations with hepatitis B and C on the scale of the Ryan White system.

5-4 The criminal justice system should screen, vaccinate, and treat hepatitis B and C in correctional facilities according to national clinical practice guidelines.

Financing Elimination

6-1 The federal government, on behalf of the Department of Health and Human Services, should purchase the rights to a direct-acting antiviral for use in neglected market segments, such as Medicaid, the Indian Health Service, and prisons. This could be done through the licensing or assigning of a patent in a voluntary transaction with an innovator pharmaceutical company.

Citation: National Academies of Science, Engineering and Medicine[83,84]

The first two aims of this dissertation align with Strategic Direction 1, which the NASEM report describes as “the need to understand viral hepatitis epidemic and response as a basis for advocacy, political commitment, national planning, resource mobilization and allocation, implementation, and program improvement.”[83] Furthermore, we focused on addressing this need for relevant descriptive data on a county-level, which is an important unit of analysis for public health implications. Counties are simultaneously small enough to capture local socioeconomic conditions yet large enough to influence policy.[131] Often, county and local health departments are responsible for implementing state or federal programs [195,196] and their activities are associated with infectious disease control.[197,198]

As previously discussed in Chapter 1, the basic epidemiologic quantities that describe new infections, morbidity and mortality are not reliably or consistently available across jurisdictions. The results from Chapter 2 add to a growing body of literature that describes the geographic impact of HCV infection[25-28,199] by providing precise and systematic small-area estimates of HCV mortality across counties and years. In 2017, CDC's National Viral Hepatitis Action Plan established a goal of reducing the national rate of hepatitis C-related deaths to 4.17 per 100,000 population by 2020.[85,86] These results allow state or federal policy makers to identify where that goal has been achieved and what counties still need additional support in reducing HCV-related mortality. In the absence of small-area HCV prevalence estimates, these results can help inform decisions necessary to carry out NASEM recommendation 4-4, which emphasizes the identification of settings appropriate for enhanced viral hepatitis testing. Although we did not focus on specific service delivery settings, counties with high HCV mortality identify geographic areas that could benefit from increased HCV screening resources and improved access to treatment. In April 2020, CDC updated HCV screening recommendations to include screening at least once per lifetime for all adults 18 years of age or older.[43] Our results demonstrated HCV mortality has increased among adults <40 years since 2013, providing additional support for this new recommendation.

Beyond the improved granularity of the geographic distribution of HCV mortality, these results have local public health relevance and utility. County and local health departments can use these data to compare HCV mortality in their county to surrounding areas or national targets defined by the public health community. Many state, county and city health departments have initiated, or are in the process of designing, their own HCV elimination programs.[200] These data provide a benchmark that local areas can use to define their own HCV mortality reduction goals moving forward.

In addition to informing efforts that aim to reduce HCV mortality, this dissertation has relevance for efforts that aim to prevent new HCV and HBV infections. Many HCV and HBV prevention activities focus on identifying new infections and reducing transmission among injection drug users.[43,115,177] NASEM recommendation 4-3 highlights the expansion of access to syringe exchange and opioid agonist therapy as an essential intervention in combating new HCV and HBV infections.[83] Consequently, in order to effectively direct these prevention resources to the most efficient area, there is a critical need to understand what areas and communities are most impacted by injection drug use. Despite this need, injection drug use behavior is constantly evolving and difficult to measure directly. In the absence of a direct measure of injection drug use, proxies such as overdose deaths[27] and incident acute HCV infections[114] are often used as indicators of injection behavior and possible ongoing transmission of infectious disease, despite their flaws and potential biases. In this dissertation, we present additional small-area data that can be interpreted in conjunction with other commonly-used proxies to help clarify understanding of injection behavior. From the results in Chapter 2, counties with relatively high HCV death rates among persons <40 years are likely to reflect infections that were primarily acquired through injection drug use.[1] Additionally, Chapter 3 presents the initial piece of a framework for thinking about the complex relationships between the prescription opioid epidemic, subsequent injection behaviors and drug overdose mortality. Quantifying the changing relationship between prescription opioid availability and overdose mortality is the first step in understanding a shift from prescription opioid use to other drugs, which may have implications for route of administration. The LPA results and county-level subgroups contribute to a quickly emerging literature that indicates structural characteristics of place are important for understanding the opioid epidemic and resulting health consequences.[131-133,135,201] Individual jurisdictions can assess this changing relationship to better understand drug overdose dynamics in their local area and design public health programs accordingly.

Beyond the provision of new data for local health departments and use by researchers, this dissertation provides results that are relevant for national public health policy makers. Recommendation 4-1 from the NASEM report emphasizes the expansion of access to adult hepatitis B vaccination through the removal of existing barriers. Although we did not provide an assessment of the entire scope of barriers to adult HBV vaccination (e.g. lack of public awareness about HBV[202], clinics failing to stock vaccination[83], confusing recommendations for adults[203], etc.), in Chapter 4 we presented an economic analysis of a streamlined universal adult vaccination recommendation that would remove at least some of the barriers surrounding HBV vaccination messaging for providers and the general public. The research question, analytic approach and presentation of results were designed in a manner that is familiar, interpretable and useful to vaccination policy makers. The project is currently part of ongoing discussion about adult HBV vaccination among the Advisory Committee on Immunization Practices (ACIP). In May 2020, this work was presented to the ACIP viral hepatitis workgroup and CDC's Division of Viral Hepatitis and will inform any forthcoming updates or modification to HBV vaccination recommendations.

Future Directions

This dissertation serves as the foundation for multiple future research directions, particularly those focused on enhancing our understanding of the geographic and place-based epidemiology of viral hepatitis. In Chapter 2 we present county-level data on reported HCV mortality, with the acknowledgment that HCV is often under recorded on death certificates.[6] Future work should explore the potential impact of misclassification of HCV mortality and if misclassification differs by place and time. Additional sensitivity analyses that incorporate a proportion of deaths attributable to common HCV sequelae (e.g. hepatocellular carcinoma, non-alcoholic cirrhosis) could provide insight into potential biases resulting from misclassification. Additionally, a natural next step is to investigate the geographic distribution of HBV mortality and recent trends. Although there may not be enough deaths to estimate reliable county-level HBV death rates and trends, rates for larger geographic areas may be possible.

This dissertation includes an early and exploratory analysis of the changing relationship between opioid prescription availability and overdose mortality that opens up a variety of research directions. In Chapter 3, we outline a theoretical framework for using the proposed metric to evaluate future research questions. Although we demonstrate the metric has changed over time and the change has been differential by place, there is a need for future research to determine how structural factors, geographic availability and toxicity of drugs, and local public health interventions all impact those changes. Many of those future questions will require the use of additional data that will need to be collected through qualitative and quantitative research. However, as those data become available, they can be incorporated into our initial framework to assess the degree to which local characteristics, policies or interventions may be responsible for the observed differences.

Finally, Chapter 4 establishes the potential economic health impact of a universal adult HBV vaccination recommendation, but future research on the actual implementation of that recommendation is needed. Our analysis found a universal HBV vaccination recommendation is more cost-effective at higher levels of vaccination coverage, indicating special attention should be given to introducing a recommendation that will achieve the largest uptake possible. Additional research should draw from implementation science[204] and previous research on the development of vaccine interventions[205] to inform an adult HBV vaccination strategy going forward.

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Appendices

Appendix A: Supplemental Material for Chapter 2

Supplemental Table 1. County-level estimated hepatitis C death rates in 2017 and average annual percent change (AAPC) during 2013-2017, United States, 2013-2017

			2017 Rate per 100,000			2013-2017 AAPC		
State	**County**	**FIPS**	**rate**	**95% CI**		**AAPC**	**95% CI**	
Alabama	Autauga	01001	2.29	1.68	3.07	-2.24	-8.95	5.98
Alabama	Baldwin	01003	3.86	3.21	4.88	-3.79	-11.71	2.89
Alabama	Barbour	01005	3.27	2.66	4.43	-5.09	-10.43	0.32
Alabama	Bibb	01007	3.36	2.52	4.75	-5.39	-11.82	2.75
Alabama	Blount	01009	2.55	1.86	3.49	-5.27	-13.43	3.00
Alabama	Bullock	01011	3.58	2.81	5.18	-5.54	-11.51	1.41
Alabama	Butler	01013	2.63	1.74	4.21	-2.89	-9.70	4.60
Alabama	Calhoun	01015	2.73	2.15	3.39	-6.32	-12.66	2.13
Alabama	Chambers	01017	3.29	2.47	4.30	-5.12	-11.38	3.28
Alabama	Cherokee	01019	3.78	2.80	5.23	-3.92	-11.75	9.63
Alabama	Chilton	01021	2.22	1.71	2.80	-4.04	-10.38	2.34
Alabama	Choctaw	01023	2.72	2.20	3.67	-0.55	-5.91	5.84
Alabama	Clarke	01025	2.90	2.14	3.92	-1.24	-6.88	5.67
Alabama	Clay	01027	*	*	*	*	*	*
Alabama	Cleburne	01029	3.44	2.61	4.76	-3.13	-10.19	4.87
Alabama	Coffee	01031	2.71	1.96	3.65	-3.44	-9.48	3.61
Alabama	Colbert	01033	3.28	2.50	4.54	-2.67	-8.71	4.70
Alabama	Conecuh	01035	3.94	2.90	5.65	-3.23	-11.50	3.34
Alabama	Coosa	01037	2.71	1.97	3.33	-5.34	-13.12	0.92
Alabama	Covington	01039	3.91	3.11	5.32	-4.63	-9.78	1.76
Alabama	Crenshaw	01041	2.85	1.67	4.25	-4.27	-11.15	3.45
Alabama	Cullman	01043	2.41	1.83	3.39	-4.56	-11.32	3.00
Alabama	Dale	01045	3.01	2.31	3.90	-4.08	-11.16	1.71
Alabama	Dallas	01047	2.39	1.87	3.31	-3.72	-10.85	3.48
Alabama	DeKalb	01049	3.15	2.32	3.96	-0.37	-6.96	7.77
Alabama	Elmore	01051	2.97	2.30	4.26	-3.56	-9.95	6.12
Alabama	Escambia	01053	6.13	4.76	8.36	-4.78	-11.30	4.50
Alabama	Etowah	01055	3.75	2.60	6.06	-7.88	-14.36	0.98
Alabama	Fayette	01057	3.05	2.32	3.95	-5.43	-13.88	1.47
Alabama	Franklin	01059	2.90	2.03	4.01	-4.08	-10.85	3.53
Alabama	Geneva	01061	3.73	2.86	5.05	-3.41	-9.43	2.98

Abbreviation: AAPC, average annual percent change; CI, confidence interval
*Indicates at least one unreliable rate between 2013 and 2017.

			2017 Rate per 100,000			2013-2017 AAPC		
State	**County**	**FIPS**	**rate**	**95% CI**		**AAPC**	**95% CI**	
Alabama	Greene	01063	3.20	2.40	4.29	-3.27	-9.22	5.47
Alabama	Hale	01065	2.81	2.22	3.84	-3.21	-10.24	4.46
Alabama	Henry	01067	2.39	1.83	4.00	-3.88	-10.66	2.22
Alabama	Houston	01069	3.08	2.16	3.79	-2.85	-10.43	3.02
Alabama	Jackson	01071	2.90	2.04	3.67	0.12	-8.88	8.76
Alabama	Jefferson	01073	3.93	3.19	4.68	-8.74	-13.88	-4.21
Alabama	Lamar	01075	3.40	2.59	4.71	-4.43	-12.32	2.39
Alabama	Lauderdale	01077	2.93	2.34	3.61	-3.67	-11.45	1.87
Alabama	Lawrence	01079	2.92	2.17	3.77	-2.42	-8.12	3.81
Alabama	Lee	01081	2.98	2.39	3.68	-5.61	-12.12	0.23
Alabama	Limestone	01083	2.54	2.00	3.27	-1.35	-7.54	4.98
Alabama	Lowndes	01085	3.05	1.75	4.27	-3.34	-10.94	3.40
Alabama	Macon	01087	3.96	2.85	5.14	-7.01	-12.88	0.14
Alabama	Madison	01089	3.26	2.55	4.00	-0.65	-6.72	6.81
Alabama	Marengo	01091	2.77	2.33	4.09	-1.66	-7.13	5.75
Alabama	Marion	01093	2.32	1.55	3.00	-3.43	-9.90	4.07
Alabama	Marshall	01095	2.46	1.80	3.41	-2.09	-11.41	5.49
Alabama	Mobile	01097	6.64	5.49	7.93	-2.67	-8.89	3.40
Alabama	Monroe	01099	3.32	2.36	4.12	-3.41	-10.86	5.15
Alabama	Montgomery	01101	3.12	2.49	3.90	-3.93	-9.81	1.97
Alabama	Morgan	01103	2.56	2.01	3.40	-3.87	-8.63	3.51
Alabama	Perry	01105	2.78	2.07	3.67	-3.51	-10.81	2.28
Alabama	Pickens	01107	3.27	2.47	4.22	-4.31	-9.31	1.72
Alabama	Pike	01109	3.97	3.00	4.97	-4.96	-9.82	0.09
Alabama	Randolph	01111	3.43	2.48	4.37	-3.86	-11.83	3.30
Alabama	Russell	01113	3.40	2.81	4.09	-5.78	-12.00	1.27
Alabama	St. Clair	01115	2.97	2.33	3.91	-7.46	-13.73	-0.66
Alabama	Shelby	01117	2.05	1.54	2.65	-5.42	-13.13	2.94
Alabama	Sumter	01119	3.32	2.46	4.62	-2.01	-7.57	3.84
Alabama	Talladega	01121	3.15	2.54	4.10	-3.64	-10.65	3.29
Alabama	Tallapoosa	01123	3.22	2.17	4.04	-5.41	-11.26	1.68
Alabama	Tuscaloosa	01125	2.18	1.67	3.03	-4.56	-9.48	2.55
Alabama	Walker	01127	3.44	2.67	5.56	-7.05	-13.30	1.46
Alabama	Washington	01129	4.07	2.87	6.39	2.07	-4.39	8.71
Alabama	Wilcox	01131	3.06	2.35	3.97	-3.34	-10.67	2.80
Alabama	Winston	01133	2.79	1.87	4.07	-4.60	-13.28	4.31
Alaska	Yukon-Fairbanks-Denali	0200A	*	*	*	*	*	*
Alaska	Northwest Arctic	0200B	*	*	*	*	*	*
Alaska	Nome	0200C	*	*	*	*	*	*
Alaska	Wade Hampton	0200D	*	*	*	*	*	*

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State	County	FIPS	2017 Rate per 100,000 rate	95% CI		2013-2017 AAPC AAPC	95% CI	
Alaska	Dillingham-Bristol Bay	0200E	*	*	*	*	*	*
Alaska	Aleutian	0200F	*	*	*	*	*	*
Alaska	Matanuska-Susitna	0200G	*	*	*	*	*	*
Alaska	Valdez-Cordova	0200H	*	*	*	*	*	*
Alaska	Anchorage	0200I	6.36	5.13	7.92	-9.49	-16.86	-2.23
Alaska	Kenai Peninsula	0200J	*	*	*	*	*	*
Alaska	Kodiak Island	0200K	*	*	*	*	*	*
Alaska	Hoonah-Angoon-Juneau	0200L	*	*	*	*	*	*
Alaska	Petersburg-Wrangell-Ketchikan	0200M	*	*	*	*	*	*
Arizona	Apache	04001	3.88	2.74	5.10	-6.51	-11.31	-0.81
Arizona	Cochise	04003	5.59	3.79	8.17	-1.78	-12.99	8.28
Arizona	Coconino	04005	4.34	3.55	5.82	-3.59	-9.30	4.01
Arizona	Gila	04007	6.88	5.23	9.32	-7.14	-14.48	0.02
Arizona	Graham	04009	5.48	4.13	7.27	-8.74	-15.83	0.08
Arizona	Greenlee	04011	*	*	*	*	*	*
Arizona	Maricopa	04013	5.08	4.60	5.62	-7.47	-10.77	-4.52
Arizona	Mohave	04015	6.77	5.62	8.11	-3.92	-9.54	2.24
Arizona	Navajo	04017	4.35	3.41	5.59	-6.53	-12.08	0.91
Arizona	Pima	04019	7.11	6.05	8.21	-4.46	-9.02	0.81
Arizona	Pinal	04021	5.69	4.62	7.09	-3.93	-9.99	2.75
Arizona	Santa Cruz	04023	3.97	2.92	5.45	-3.74	-13.57	6.64
Arizona	Yavapai	04025	6.19	4.96	7.65	-7.99	-13.66	-2.37
Arizona	Yuma	04027	5.87	4.89	7.77	-6.32	-12.15	-1.25
Arkansas	Arkansas	05001	*	*	*	*	*	*
Arkansas	Ashley	05003	3.21	2.58	4.22	-4.23	-11.51	1.37
Arkansas	Baxter	05005	3.44	2.38	4.56	-2.26	-10.51	9.01
Arkansas	Benton	05007	3.90	3.22	5.20	-4.22	-11.90	2.63
Arkansas	Boone	05009	3.11	2.05	4.03	-4.61	-13.59	3.16
Arkansas	Bradley	05011	*	*	*	*	*	*
Arkansas	Calhoun	05013	3.42	2.50	5.01	-0.15	-6.45	8.78
Arkansas	Carroll	05015	3.72	2.79	5.29	-5.08	-11.04	2.53
Arkansas	Chicot	05017	3.88	2.99	5.21	-3.93	-9.07	0.89
Arkansas	Clark	05019	4.10	3.00	5.50	1.67	-5.32	10.28
Arkansas	Clay	05021	3.95	3.01	5.52	-2.36	-11.22	7.87
Arkansas	Cleburne	05023	6.38	4.37	9.49	1.61	-8.19	13.19
Arkansas	Cleveland	05025	*	*	*	*	*	*
Arkansas	Columbia	05027	4.00	3.35	5.35	-2.08	-6.88	5.33
Arkansas	Conway	05029	4.71	3.08	6.80	-0.22	-6.65	7.78
Arkansas	Craighead	05031	3.98	2.96	5.88	0.57	-7.89	9.01
Arkansas	Crawford	05033	5.45	4.24	7.56	-0.82	-6.29	5.61

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State	County	FIPS	2017 Rate per 100,000 rate	95% CI		2013-2017 AAPC AAPC	95% CI	
Arkansas	Crittenden	05035	4.88	4.03	5.97	-3.18	-8.21	2.32
Arkansas	Cross	05037	3.98	2.80	5.64	-1.23	-8.77	5.38
Arkansas	Dallas	05039	4.37	3.26	5.81	1.55	-5.46	7.21
Arkansas	Desha	05041	4.25	3.54	5.50	-1.78	-9.03	4.47
Arkansas	Drew	05043	2.78	2.11	3.58	-3.26	-10.52	4.80
Arkansas	Faulkner	05045	4.87	3.65	6.46	0.86	-5.41	9.03
Arkansas	Franklin	05047	4.86	3.53	6.82	-0.28	-10.64	11.40
Arkansas	Fulton	05049	4.65	3.51	6.33	-1.29	-7.47	6.00
Arkansas	Garland	05051	5.19	4.19	6.89	0.00	-7.32	7.90
Arkansas	Grant	05053	4.58	3.39	6.31	-0.67	-7.74	7.06
Arkansas	Greene	05055	5.73	4.12	7.76	-1.06	-9.10	10.20
Arkansas	Hempstead	05057	5.91	4.66	7.43	0.58	-6.22	10.12
Arkansas	Hot Spring	05059	6.92	4.75	9.91	1.33	-5.36	9.95
Arkansas	Howard	05061	4.89	3.55	6.62	3.18	-4.37	12.86
Arkansas	Independence	05063	4.40	3.35	5.72	0.03	-7.26	7.07
Arkansas	Izard	05065	4.76	3.61	6.82	-0.04	-6.97	7.66
Arkansas	Jackson	05067	5.00	3.83	7.28	-0.23	-7.17	9.52
Arkansas	Jefferson	05069	5.09	4.26	6.54	-0.24	-5.92	6.09
Arkansas	Johnson	05071	3.43	2.08	4.88	-4.52	-13.97	3.65
Arkansas	Lafayette	05073	5.43	4.06	7.46	1.80	-4.90	9.30
Arkansas	Lawrence	05075	*	*	*	*	*	*
Arkansas	Lee	05077	4.12	3.02	5.30	-3.03	-9.69	2.51
Arkansas	Lincoln	05079	4.17	2.97	5.47	-3.04	-10.77	5.99
Arkansas	Little River	05081	6.35	4.87	8.84	-0.08	-8.02	9.83
Arkansas	Logan	05083	7.02	5.27	9.59	-2.43	-8.86	5.61
Arkansas	Lonoke	05085	5.54	4.46	6.77	-0.09	-7.13	6.38
Arkansas	Madison	05087	4.58	3.08	5.87	-3.82	-14.12	5.27
Arkansas	Marion	05089	2.53	1.82	3.62	-3.19	-11.11	3.76
Arkansas	Miller	05091	6.76	4.65	8.53	1.36	-4.77	9.04
Arkansas	Mississippi	05093	5.30	4.08	6.58	-3.00	-8.11	2.94
Arkansas	Monroe	05095	3.12	2.29	4.61	-2.80	-8.55	4.78
Arkansas	Montgomery	05097	3.53	2.54	5.40	2.68	-4.85	11.15
Arkansas	Nevada	05099	5.62	4.16	6.85	0.36	-7.14	8.20
Arkansas	Newton	05101	3.23	2.43	4.54	-6.11	-15.49	0.86
Arkansas	Ouachita	05103	4.35	3.34	5.91	0.24	-5.30	6.87
Arkansas	Perry	05105	6.17	4.67	8.33	-0.42	-8.56	7.25
Arkansas	Phillips	05107	3.94	2.99	4.84	-4.36	-10.65	1.37
Arkansas	Pike	05109	4.07	2.96	5.49	2.02	-7.97	9.67
Arkansas	Poinsett	05111	4.40	2.83	7.14	-0.23	-8.26	7.17
Arkansas	Polk	05113	5.11	3.50	7.29	0.55	-8.01	9.02

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State	County	FIPS	2017 Rate per 100,000 rate	95% CI		2013-2017 AAPC AAPC	95% CI	
Arkansas	Pope	05115	3.97	3.00	5.10	-4.28	-10.84	3.07
Arkansas	Prairie	05117	5.21	3.86	6.77	-1.47	-9.15	7.71
Arkansas	Pulaski	05119	5.96	4.92	7.17	1.07	-4.59	7.11
Arkansas	Randolph	05121	4.34	3.06	6.09	0.91	-7.63	10.35
Arkansas	St. Francis	05123	3.43	2.64	4.38	-1.71	-7.19	7.03
Arkansas	Saline	05125	4.92	3.41	6.50	-0.57	-9.45	7.88
Arkansas	Scott	05127	4.22	3.10	5.41	3.29	-6.53	10.87
Arkansas	Searcy	05129	*	*	*	*	*	*
Arkansas	Sebastian	05131	4.85	3.88	6.10	2.49	-3.99	10.24
Arkansas	Sevier	05133	5.24	4.06	7.46	1.15	-6.73	10.22
Arkansas	Sharp	05135	4.89	3.40	6.11	1.34	-4.88	11.12
Arkansas	Stone	05137	3.65	2.81	4.93	2.69	-4.57	11.30
Arkansas	Union	05139	4.02	3.36	5.83	-4.37	-10.65	5.37
Arkansas	Van Buren	05141	4.56	3.32	5.75	-1.14	-7.51	8.84
Arkansas	Washington	05143	5.46	3.90	6.99	-1.31	-8.05	6.94
Arkansas	White	05145	4.74	3.52	6.67	-0.12	-7.81	7.82
Arkansas	Woodruff	05147	4.65	3.19	6.71	-1.83	-9.38	7.30
Arkansas	Yell	05149	5.20	4.09	6.76	-0.49	-8.68	9.77
California	Alameda	06001	4.93	4.26	5.60	-10.18	-13.79	-6.63
California	Alpine	06003	5.31	3.86	6.62	-8.36	-14.42	0.69
California	Amador	06005	5.29	3.60	7.39	-9.00	-20.42	-0.92
California	Butte	06007	14.78	12.37	17.44	-6.63	-11.47	-1.58
California	Calaveras	06009	6.17	4.08	10.10	-6.42	-13.84	1.68
California	Colusa	06011	8.50	6.46	13.39	-7.61	-14.45	1.29
California	Contra Costa	06013	4.71	3.81	5.55	-7.82	-13.46	-3.24
California	Del Norte	06015	13.72	9.17	18.36	-2.04	-8.57	8.41
California	El Dorado	06017	5.42	3.92	6.76	-6.07	-11.87	0.49
California	Fresno	06019	7.14	6.02	8.18	-8.40	-12.75	-4.30
California	Glenn	06021	7.78	5.47	11.66	-5.63	-13.25	4.26
California	Humboldt	06023	15.97	12.77	20.77	-6.55	-12.90	0.14
California	Imperial	06025	7.68	5.74	10.13	-8.47	-15.85	-0.15
California	Inyo	06027	6.47	4.65	8.33	-5.82	-14.52	0.24
California	Kern	06029	9.30	8.10	10.77	-7.16	-11.10	-3.30
California	Kings	06031	8.98	6.83	10.97	-5.42	-12.66	0.77
California	Lake	06033	11.86	9.45	15.27	-12.32	-18.18	-6.47
California	Lassen	06035	6.38	4.84	8.26	-12.75	-19.39	-4.31
California	Los Angeles	06037	4.41	4.10	4.79	-8.76	-10.79	-6.54
California	Madera	06039	8.25	6.59	10.11	-7.41	-13.00	-1.11
California	Marin	06041	4.93	3.75	6.64	-6.46	-15.44	3.05
California	Mariposa	06043	6.42	4.33	9.06	-5.30	-13.08	3.58

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			2017 Rate per 100,000			2013-2017 AAPC		
State	**County**	**FIPS**	**rate**	**95% CI**		**AAPC**	**95% CI**	
California	Mendocino	06045	10.00	7.70	13.22	-8.21	-14.88	0.74
California	Merced	06047	10.46	8.45	12.83	-9.46	-14.44	-4.39
California	Modoc	06049	6.91	4.83	9.24	-10.06	-19.86	2.43
California	Mono	06051	4.86	3.81	6.14	-5.87	-12.02	0.75
California	Monterey	06053	4.68	3.51	6.01	-9.10	-15.27	-2.61
California	Napa	06055	6.32	4.92	7.97	-9.27	-18.72	-1.19
California	Nevada	06057	5.08	4.03	6.64	-6.49	-13.46	0.87
California	Orange	06059	2.97	2.56	3.44	-12.40	-16.36	-8.12
California	Placer	06061	4.62	3.61	5.52	-7.32	-13.53	-1.26
California	Plumas	06063	6.61	4.52	9.23	-6.72	-15.20	2.36
California	Riverside	06065	5.58	4.87	6.24	-10.30	-13.77	-6.85
California	Sacramento	06067	9.50	8.44	10.72	-6.03	-9.47	-2.68
California	San Benito	06069	5.24	3.86	7.48	-9.17	-15.48	-2.75
California	San Bernardino	06071	7.15	6.50	7.93	-10.41	-13.55	-7.18
California	San Diego	06073	6.08	5.45	6.73	-8.84	-11.71	-6.11
California	San Francisco	06075	7.40	6.05	9.02	-10.40	-16.55	-4.62
California	San Joaquin	06077	7.67	6.64	8.95	-6.32	-10.40	-1.20
California	San Luis Obispo	06079	5.75	4.60	7.27	-8.16	-14.00	-1.64
California	San Mateo	06081	2.70	2.21	3.46	-13.76	-19.04	-7.49
California	Santa Barbara	06083	7.81	6.29	9.84	-8.50	-15.11	-2.52
California	Santa Clara	06085	3.88	3.32	4.50	-8.93	-12.82	-4.86
California	Santa Cruz	06087	5.30	4.05	7.35	-11.50	-17.94	-4.07
California	Shasta	06089	11.24	8.47	14.43	-10.87	-17.18	-3.13
California	Sierra	06091	5.34	3.86	7.51	-5.98	-13.99	0.89
California	Siskiyou	06093	8.56	6.65	10.94	-5.92	-12.20	1.01
California	Solano	06095	9.95	8.23	11.72	-10.15	-14.91	-5.95
California	Sonoma	06097	6.49	5.43	7.84	-10.62	-15.22	-5.33
California	Stanislaus	06099	11.24	9.37	13.65	-6.07	-11.44	-1.61
California	Sutter	06101	8.78	6.47	11.53	-6.56	-12.61	0.51
California	Tehama	06103	11.17	8.95	15.38	-6.92	-13.81	0.22
California	Trinity	06105	10.72	8.27	14.38	-8.27	-15.96	0.03
California	Tulare	06107	9.72	7.87	12.32	-4.35	-9.49	2.26
California	Tuolumne	06109	6.31	4.83	8.59	-8.32	-15.25	-1.35
California	Ventura	06111	5.38	4.45	7.04	-10.63	-15.42	-5.12
California	Yolo	06113	9.30	7.01	11.24	-9.64	-15.50	-4.12
California	Yuba	06115	12.41	10.10	15.82	-4.72	-11.15	1.77
Colorado	Adams	08001	5.77	4.68	6.94	-2.27	-7.47	3.14
Colorado	Alamosa	08003	6.37	4.59	10.67	-4.08	-12.75	5.50
Colorado	Arapahoe	08005	4.76	3.85	5.55	1.69	-4.60	7.22
Colorado	Archuleta	08007	4.95	3.21	7.05	-4.31	-11.51	2.07

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Colorado	Baca	08009	5.65	3.46	7.76	-4.32	-12.10	5.06
Colorado	Bent	08011	7.50	5.21	9.55	-4.37	-11.51	4.31
Colorado	Boulder	08013	3.49	2.80	4.32	0.84	-6.07	8.35
Colorado	Chaffee	08015	3.34	2.55	5.13	-2.57	-9.63	4.02
Colorado	Cheyenne	08017	*	*	*	*	*	*
Colorado	Clear Creek	08019	4.76	3.28	6.90	-2.72	-10.18	6.50
Colorado	Conejos	08021	6.29	4.47	8.72	-6.16	-13.80	3.03
Colorado	Costilla	08023	4.78	2.99	6.60	-6.03	-15.38	2.04
Colorado	Crowley	08025	8.47	6.09	13.36	0.27	-8.52	8.50
Colorado	Custer	08027	5.39	3.96	7.60	-3.53	-11.64	3.85
Colorado	Delta	08029	3.73	2.28	5.67	-2.89	-12.43	6.50
Colorado	Denver	08031	11.99	10.10	14.00	-0.62	-4.57	5.25
Colorado	Dolores	08033	4.76	3.09	6.46	-1.72	-9.57	7.37
Colorado	Douglas	08035	2.38	1.83	3.02	6.29	0.16	13.46
Colorado	Eagle	08037	2.93	2.28	4.12	-1.48	-10.51	6.59
Colorado	Elbert	08039	2.91	1.91	4.42	0.86	-8.55	9.39
Colorado	El Paso	08041	6.90	5.78	8.24	0.54	-5.05	6.50
Colorado	Fremont	08043	10.85	8.50	13.18	-6.57	-13.30	0.09
Colorado	Garfield	08045	4.15	2.99	5.57	-1.86	-7.81	4.30
Colorado	Gilpin	08047	4.71	3.19	6.91	-0.34	-14.38	7.49
Colorado	Grand	08049	3.35	2.09	4.81	-0.22	-7.62	7.27
Colorado	Gunnison	08051	3.45	2.60	4.75	-2.53	-11.00	4.62
Colorado	Hinsdale	08053	4.83	3.10	7.08	-2.68	-9.68	6.16
Colorado	Huerfano	08055	5.75	4.45	7.91	-3.02	-10.04	4.14
Colorado	Jackson	08057	*	*	*	*	*	*
Colorado	Jefferson	08059	4.36	3.57	5.22	-0.21	-6.40	4.96
Colorado	Kiowa	08061	4.83	3.69	7.23	-2.05	-8.69	4.68
Colorado	Kit Carson	08063	4.79	3.37	6.83	-1.29	-13.54	8.15
Colorado	Lake	08065	3.97	2.84	5.56	-3.89	-10.29	3.98
Colorado	La Plata	08067	3.75	2.80	5.05	-3.35	-10.47	4.75
Colorado	Larimer	08069	4.04	3.24	5.12	-0.47	-5.38	7.27
Colorado	Las Animas	08071	6.13	4.72	8.09	-5.82	-14.39	2.16
Colorado	Lincoln	08073	4.26	3.07	5.45	1.04	-7.95	7.18
Colorado	Logan	08075	4.72	3.65	6.57	-0.82	-8.51	5.74
Colorado	Mesa	08077	5.42	4.26	7.11	-4.37	-10.87	1.71
Colorado	Mineral	08079	*	*	*	*	*	*
Colorado	Moffat	08081	3.65	2.39	5.50	-1.89	-9.06	5.52
Colorado	Montezuma	08083	3.37	2.40	4.89	-3.78	-12.24	5.30
Colorado	Montrose	08085	4.51	3.59	5.86	-4.91	-10.61	2.23
Colorado	Morgan	08087	3.69	2.63	5.01	-1.63	-12.11	7.11

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*Indicates at least one unreliable rate between 2013 and 2017.

			2017 Rate per 100,000			2013-2017 AAPC		
State	**County**	**FIPS**	**rate**	**95% CI**		**AAPC**	**95% CI**	
Colorado	Otero	08089	5.57	3.97	7.21	-2.09	-8.89	3.79
Colorado	Ouray	08091	4.75	3.32	6.31	-4.17	-10.86	5.30
Colorado	Park	08093	4.28	3.10	5.91	-1.47	-8.53	6.17
Colorado	Phillips	08095	4.51	2.95	7.04	0.77	-10.61	12.39
Colorado	Pitkin	08097	*	*	*	*	*	*
Colorado	Prowers	08099	5.84	3.97	8.03	-1.87	-8.78	5.53
Colorado	Pueblo	08101	8.12	6.52	10.09	0.01	-6.36	6.49
Colorado	Rio Blanco	08103	4.45	2.61	6.38	-3.67	-12.72	5.39
Colorado	Rio Grande	08105	5.71	4.27	7.77	-4.44	-12.99	4.57
Colorado	Routt	08107	3.46	2.59	5.15	-0.40	-8.15	6.99
Colorado	Saguache	08109	4.53	3.12	6.09	-3.80	-10.71	4.00
Colorado	San Juan	08111	3.98	2.77	5.52	-2.08	-9.35	7.02
Colorado	San Miguel	08113	3.77	2.61	5.83	-3.43	-10.52	5.30
Colorado	Sedgwick	08115	4.09	2.98	5.81	-0.40	-6.83	6.81
Colorado	Summit	08117	2.74	2.11	3.80	-2.25	-9.51	7.88
Colorado	Teller	08119	6.09	4.66	8.66	0.72	-7.09	9.54
Colorado	Washington	08121	*	*	*	*	*	*
Colorado	Weld	08123	5.17	4.19	6.25	0.35	-5.06	6.75
Colorado	Yuma	08125	4.19	3.11	5.43	-1.67	-9.35	8.52
Connecticut	Fairfield	09001	1.82	1.44	2.23	-8.34	-13.48	-2.77
Connecticut	Hartford	09003	3.62	3.01	4.44	-3.39	-8.84	2.72
Connecticut	Litchfield	09005	1.96	1.55	2.50	-6.51	-12.08	-0.44
Connecticut	Middlesex	09007	2.32	1.47	3.06	-4.68	-11.60	4.98
Connecticut	New Haven	09009	3.42	2.79	4.33	-6.04	-11.85	-0.12
Connecticut	New London	09011	2.84	2.23	3.53	-9.42	-14.36	-2.30
Connecticut	Tolland	09013	2.68	1.91	3.82	-5.87	-12.38	2.32
Connecticut	Windham	09015	3.24	2.27	4.55	-6.12	-13.29	2.41
Delaware	Kent	10001	4.06	3.25	5.28	-6.19	-12.24	1.58
Delaware	New Castle	10003	3.88	3.24	4.62	-5.78	-10.23	-1.18
Delaware	Sussex	10005	2.62	2.13	3.33	-9.16	-16.71	-1.97
District of Columbia	District of Columbia	11001	11.57	9.84	13.44	-5.31	-10.41	-0.90
Florida	Alachua	12001	6.68	5.48	8.00	-5.04	-10.59	-0.03
Florida	Baker	12003	7.00	5.36	9.46	-0.34	-6.46	4.73
Florida	Bay	12005	7.00	5.27	8.98	-10.13	-16.42	-3.68
Florida	Bradford	12007	10.02	7.90	13.19	-1.78	-8.48	7.42
Florida	Brevard	12009	5.60	4.72	6.68	-0.41	-5.93	8.12
Florida	Broward	12011	2.58	2.23	3.05	-5.75	-10.38	-0.80
Florida	Calhoun	12013	5.65	4.21	8.00	-7.61	-14.29	1.01
Florida	Charlotte	12015	4.95	3.76	6.38	2.32	-7.13	12.22
Florida	Citrus	12017	4.26	3.45	6.05	-4.37	-11.01	4.51

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State	County	FIPS	2017 Rate per 100,000 rate	95% CI		2013-2017 AAPC AAPC	95% CI	
Florida	Clay	12019	4.17	3.47	5.67	-3.36	-8.97	3.36
Florida	Collier	12021	2.44	1.91	3.03	-7.73	-13.36	-2.33
Florida	Columbia	12023	10.44	7.82	12.92	2.22	-4.31	8.67
Florida	DeSoto	12027	5.53	3.81	7.44	2.26	-6.02	14.12
Florida	Dixie	12029	11.93	8.20	16.81	0.35	-9.18	10.51
Florida	Duval	12031	8.21	7.21	9.59	1.69	-2.43	6.29
Florida	Escambia	12033	6.18	5.11	7.80	0.05	-5.87	6.32
Florida	Flagler	12035	4.62	3.27	6.18	-4.52	-12.62	4.89
Florida	Franklin	12037	*	*	*	*	*	*
Florida	Gadsden	12039	4.39	3.26	5.68	-5.78	-12.83	-0.60
Florida	Gilchrist	12041	7.33	4.94	11.24	-2.44	-9.06	5.05
Florida	Glades	12043	4.85	3.72	7.63	-4.00	-11.67	5.57
Florida	Gulf	12045	5.93	4.29	7.97	-9.63	-15.25	-0.47
Florida	Hamilton	12047	9.20	6.00	12.42	1.64	-9.35	11.58
Florida	Hardee	12049	4.33	2.74	5.63	0.37	-8.82	9.72
Florida	Hendry	12051	3.75	2.72	5.42	-3.48	-9.30	5.25
Florida	Hernando	12053	3.68	2.58	5.25	-1.77	-11.80	7.75
Florida	Highlands	12055	3.84	3.08	5.13	-1.10	-10.46	7.09
Florida	Hillsborough	12057	4.14	3.46	4.90	-4.32	-9.12	1.16
Florida	Holmes	12059	4.33	3.13	6.30	-6.05	-12.45	3.80
Florida	Indian River	12061	4.10	3.05	5.28	-1.90	-9.59	9.63
Florida	Jackson	12063	4.32	3.26	5.43	-6.15	-12.95	1.87
Florida	Jefferson	12065	5.76	4.42	7.52	-1.65	-7.75	6.76
Florida	Lafayette	12067	*	*	*	*	*	*
Florida	Lake	12069	3.50	2.80	4.19	-4.28	-10.52	2.44
Florida	Lee	12071	3.07	2.38	4.00	-8.78	-15.54	-0.21
Florida	Leon	12073	5.06	4.09	6.77	-3.88	-10.05	2.77
Florida	Levy	12075	7.57	5.12	10.87	-4.26	-10.43	3.64
Florida	Liberty	12077	5.08	3.83	7.28	-5.75	-13.84	2.82
Florida	Madison	12079	5.88	4.27	7.37	-0.23	-5.99	7.20
Florida	Manatee	12081	3.97	3.27	4.84	2.38	-4.13	10.27
Florida	Marion	12083	6.70	5.51	7.90	-0.92	-5.96	5.19
Florida	Martin	12085	4.34	3.30	6.12	1.09	-8.57	13.25
Florida	Miami-Dade	12086	2.34	1.97	2.73	-7.99	-12.28	-2.09
Florida	Monroe	12087	5.53	3.96	7.58	-14.23	-21.78	-5.39
Florida	Nassau	12089	4.77	3.03	7.06	-1.31	-10.57	8.00
Florida	Okaloosa	12091	3.99	3.07	5.25	-2.24	-9.40	6.23
Florida	Okeechobee	12093	4.62	3.63	6.09	-3.70	-9.27	2.26
Florida	Orange	12095	4.46	3.74	5.24	-3.00	-7.38	2.57
Florida	Osceola	12097	4.36	3.36	5.27	-0.27	-6.60	6.73

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State	County	FIPS	2017 Rate per 100,000 rate	95% CI		2013-2017 AAPC AAPC	95% CI	
Florida	Palm Beach	12099	2.81	2.31	3.49	-6.96	-12.24	0.12
Florida	Pasco	12101	4.89	3.88	5.97	-3.27	-10.24	2.39
Florida	Pinellas	12103	4.76	3.88	5.51	-6.70	-11.89	-1.97
Florida	Polk	12105	4.12	3.39	4.84	-4.07	-9.16	0.93
Florida	Putnam	12107	8.69	6.75	10.73	-3.58	-10.68	2.10
Florida	St. Johns	12109	3.87	3.13	4.75	-0.99	-7.72	5.69
Florida	St. Lucie	12111	5.49	4.46	6.89	3.39	-3.79	10.71
Florida	Santa Rosa	12113	4.48	3.02	6.17	0.75	-7.67	11.87
Florida	Sarasota	12115	4.24	3.31	5.34	11.96	-0.14	22.77
Florida	Seminole	12117	3.46	2.72	4.26	-2.54	-10.38	5.74
Florida	Sumter	12119	3.43	2.77	4.62	-1.19	-9.44	6.89
Florida	Suwannee	12121	8.76	6.87	12.11	2.47	-6.03	11.97
Florida	Taylor	12123	6.51	4.97	8.44	2.37	-4.17	10.53
Florida	Union	12125	62.08	42.59	89.97	-5.25	-12.58	4.80
Florida	Volusia	12127	6.41	5.40	7.75	-4.44	-9.31	0.94
Florida	Wakulla	12129	7.50	5.44	10.52	-5.37	-15.01	2.54
Florida	Walton	12131	4.80	3.25	6.87	-6.99	-13.46	0.13
Florida	Washington	12133	5.23	3.30	6.95	-5.10	-11.32	3.09
Georgia	Appling	13001	3.54	2.34	5.42	-4.38	-9.84	3.44
Georgia	Atkinson	13003	4.22	3.22	6.04	-3.71	-11.93	4.04
Georgia	Bacon	13005	3.64	2.65	5.56	-2.56	-11.13	5.20
Georgia	Baker	13007	3.92	2.53	5.06	-6.54	-12.77	0.94
Georgia	Baldwin	13009	4.14	3.35	5.74	-3.26	-9.70	4.16
Georgia	Banks	13011	4.66	3.68	6.01	-2.99	-9.71	5.44
Georgia	Barrow	13013	3.07	2.36	4.30	-4.24	-11.12	4.52
Georgia	Bartow	13015	3.66	2.42	4.84	-3.00	-9.92	6.39
Georgia	Ben Hill	13017	*	*	*	*	*	*
Georgia	Berrien	13019	3.23	2.27	4.59	-3.27	-9.28	2.63
Georgia	Bibb	13021	3.19	2.40	4.46	-8.09	-13.75	-1.78
Georgia	Bleckley	13023	3.77	2.42	5.82	-5.56	-13.12	0.92
Georgia	Brantley	13025	5.01	3.62	7.22	-0.57	-10.42	8.14
Georgia	Brooks	13027	4.94	3.81	6.64	-3.86	-10.61	3.44
Georgia	Bryan	13029	3.86	2.64	5.37	0.91	-5.99	9.17
Georgia	Bulloch	13031	3.23	2.50	4.49	0.80	-6.29	11.20
Georgia	Burke	13033	3.65	2.88	4.60	-1.46	-7.48	3.47
Georgia	Butts	13035	3.21	2.39	4.23	-10.02	-15.60	-2.78
Georgia	Calhoun	13037	3.34	2.39	4.50	-6.76	-14.25	-0.30
Georgia	Camden	13039	4.27	2.79	5.79	-0.18	-9.47	9.03
Georgia	Candler	13043	4.35	3.23	5.95	0.06	-6.33	9.07
Georgia	Carroll	13045	3.36	2.73	4.26	-4.43	-10.36	1.54

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			2017 Rate per 100,000			2013-2017 AAPC		
State	**County**	**FIPS**	**rate**	**95% CI**		**AAPC**	**95% CI**	
Georgia	Catoosa	13047	4.06	2.72	5.72	-1.92	-12.51	6.81
Georgia	Charlton	13049	5.59	4.33	7.27	-4.06	-11.72	3.28
Georgia	Chatham	13051	4.77	3.75	6.36	-1.36	-8.68	6.32
Georgia	Chattahoochee	13053	3.53	2.60	5.01	-7.42	-13.53	0.34
Georgia	Chattooga	13055	5.76	4.16	8.62	0.00	-11.93	13.40
Georgia	Cherokee	13057	2.13	1.60	2.78	-3.62	-10.27	3.76
Georgia	Clarke	13059	3.28	2.28	4.45	-1.65	-9.57	8.14
Georgia	Clay	13061	2.87	2.35	3.91	-5.19	-11.74	2.24
Georgia	Clayton	13063	3.00	2.36	4.02	-6.23	-12.71	0.51
Georgia	Clinch	13065	5.20	3.61	8.12	-0.40	-7.99	6.33
Georgia	Cobb	13067	2.32	1.95	3.08	-2.20	-7.76	3.47
Georgia	Coffee	13069	2.87	2.00	4.00	-2.59	-8.37	3.26
Georgia	Colquitt	13071	3.15	2.39	4.30	-3.06	-9.03	2.61
Georgia	Columbia	13073	3.19	2.51	4.67	-2.75	-10.07	6.29
Georgia	Cook	13075	4.48	3.08	6.19	-4.69	-12.50	3.59
Georgia	Coweta	13077	3.15	2.47	4.37	-5.61	-11.57	1.90
Georgia	Crawford	13079	3.77	3.06	5.43	-7.28	-13.15	0.84
Georgia	Crisp	13081	3.73	2.74	5.40	-1.05	-8.00	5.70
Georgia	Dade	13083	4.23	3.01	6.44	0.80	-8.47	9.61
Georgia	Dawson	13085	3.72	2.45	5.63	-3.40	-11.51	4.40
Georgia	Decatur	13087	3.21	2.37	4.39	-5.42	-12.61	1.48
Georgia	DeKalb	13089	3.04	2.47	3.78	-4.08	-9.44	1.68
Georgia	Dodge	13091	3.48	2.32	4.87	-5.64	-10.81	1.75
Georgia	Dooly	13093	2.99	2.25	4.54	-3.64	-9.20	4.22
Georgia	Dougherty	13095	4.12	3.33	5.25	-7.49	-14.31	-0.67
Georgia	Douglas	13097	2.49	1.93	3.57	-2.32	-8.47	5.00
Georgia	Early	13099	2.99	2.31	4.06	-5.75	-11.38	2.41
Georgia	Echols	13101	6.58	4.35	10.52	3.24	-4.67	12.06
Georgia	Effingham	13103	4.24	2.62	5.43	-0.33	-9.48	6.20
Georgia	Elbert	13105	3.70	3.05	4.65	-1.66	-7.71	4.04
Georgia	Emanuel	13107	3.33	2.71	4.36	-0.64	-7.20	5.25
Georgia	Evans	13109	3.30	2.39	4.46	-0.90	-8.22	7.44
Georgia	Fannin	13111	*	*	*	*	*	*
Georgia	Fayette	13113	1.81	1.37	2.99	-5.60	-10.75	2.49
Georgia	Floyd	13115	5.24	4.05	7.20	-1.51	-9.16	8.00
Georgia	Forsyth	13117	1.58	1.28	2.41	-2.09	-9.36	7.26
Georgia	Franklin	13119	3.51	2.50	5.01	-1.55	-9.64	10.32
Georgia	Fulton	13121	3.66	3.14	4.32	-7.77	-11.47	-3.36
Georgia	Gilmer	13123	3.84	2.70	6.00	-1.97	-9.78	9.64
Georgia	Glascock	13125	4.60	1.95	5.94	-2.24	-12.96	6.56

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State	County	FIPS	2017 Rate per 100,000 rate	95% CI		2013-2017 AAPC AAPC	95% CI	
Georgia	Glynn	13127	4.26	3.23	6.22	1.71	-10.81	10.79
Georgia	Gordon	13129	4.25	2.74	5.66	-4.47	-11.21	3.12
Georgia	Grady	13131	3.03	2.39	4.13	-2.94	-10.49	5.53
Georgia	Greene	13133	2.59	1.96	3.39	-2.60	-9.23	5.98
Georgia	Gwinnett	13135	2.03	1.66	2.36	-2.94	-7.94	1.25
Georgia	Habersham	13137	3.24	2.38	4.16	-2.79	-9.51	4.80
Georgia	Hall	13139	3.46	2.61	4.36	-2.49	-9.45	5.03
Georgia	Hancock	13141	4.13	2.95	5.65	-2.30	-8.23	4.30
Georgia	Haralson	13143	*	*	*	*	*	*
Georgia	Harris	13145	2.60	1.94	3.31	-5.74	-16.10	1.51
Georgia	Hart	13147	3.40	2.59	4.41	-3.53	-10.35	3.73
Georgia	Heard	13149	*	*	*	*	*	*
Georgia	Henry	13151	2.15	1.70	2.65	-6.32	-12.04	-0.67
Georgia	Houston	13153	3.31	2.21	4.03	-5.75	-13.50	0.04
Georgia	Irwin	13155	3.99	3.22	5.24	-1.65	-8.46	6.17
Georgia	Jackson	13157	3.41	2.51	5.75	-3.81	-9.80	4.94
Georgia	Jasper	13159	2.82	2.09	3.96	-6.70	-12.76	-1.01
Georgia	Jeff Davis	13161	4.11	3.10	5.38	-3.72	-10.67	3.37
Georgia	Jefferson	13163	3.73	2.75	4.85	-2.38	-8.37	1.91
Georgia	Jenkins	13165	4.06	3.06	6.39	-1.29	-7.21	7.28
Georgia	Johnson	13167	3.79	2.37	5.11	-3.16	-8.73	3.47
Georgia	Jones	13169	3.02	2.51	4.12	-4.86	-10.18	1.48
Georgia	Lamar	13171	3.36	2.59	4.58	-8.39	-16.11	-1.73
Georgia	Lanier	13173	3.63	2.53	5.21	-1.86	-7.24	5.78
Georgia	Laurens	13175	2.73	1.90	3.62	-5.06	-10.44	0.01
Georgia	Lee	13177	3.78	2.70	4.76	-4.99	-13.02	1.95
Georgia	Liberty	13179	3.78	2.62	5.06	-1.20	-6.94	5.96
Georgia	Lincoln	13181	3.65	2.76	4.86	1.20	-7.65	14.95
Georgia	Long	13183	4.42	3.07	6.43	-2.01	-10.06	7.19
Georgia	Lowndes	13185	4.89	3.86	6.14	-1.01	-8.56	5.44
Georgia	Lumpkin	13187	4.34	3.05	6.92	-2.33	-11.46	10.38
Georgia	McDuffie	13189	4.11	3.18	5.44	-2.00	-9.41	4.67
Georgia	McIntosh	13191	4.06	3.20	5.99	-1.86	-8.77	7.98
Georgia	Macon	13193	4.03	2.79	5.24	-8.06	-13.76	-1.27
Georgia	Madison	13195	2.94	2.27	3.88	-3.14	-9.46	5.38
Georgia	Marion	13197	3.48	2.58	4.62	-7.21	-13.32	0.06
Georgia	Meriwether	13199	2.93	2.27	3.88	-8.69	-16.22	-0.23
Georgia	Miller	13201	3.94	2.48	5.97	-4.32	-12.18	6.15
Georgia	Mitchell	13205	3.90	2.87	5.94	-3.18	-10.43	2.34
Georgia	Monroe	13207	3.40	2.67	4.70	-7.34	-13.24	-0.83

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			2017 Rate per 100,000			2013-2017 AAPC		
State	**County**	**FIPS**	**rate**	**95% CI**		**AAPC**	**95% CI**	
Georgia	Montgomery	13209	3.63	2.67	4.69	-3.67	-9.22	4.25
Georgia	Morgan	13211	2.30	1.80	2.94	-5.24	-11.29	3.21
Georgia	Murray	13213	3.54	2.54	5.20	-3.18	-14.24	4.88
Georgia	Muscogee	13215	4.42	3.57	5.60	-8.40	-14.42	-1.33
Georgia	Newton	13217	2.50	1.83	3.15	-7.69	-13.37	-1.61
Georgia	Oconee	13219	2.46	1.42	3.19	-2.62	-10.61	4.87
Georgia	Oglethorpe	13221	3.55	2.56	5.40	-3.07	-9.09	4.45
Georgia	Paulding	13223	2.88	2.36	3.79	-1.70	-6.87	5.22
Georgia	Peach	13225	4.31	3.45	5.19	-6.22	-13.78	0.87
Georgia	Pickens	13227	3.74	2.39	5.59	-3.27	-12.14	6.12
Georgia	Pierce	13229	4.17	2.78	6.00	-1.94	-9.54	5.73
Georgia	Pike	13231	*	*	*	*	*	*
Georgia	Polk	13233	4.23	3.13	6.21	-1.35	-8.48	8.93
Georgia	Pulaski	13235	3.07	1.72	3.66	-4.47	-11.26	2.43
Georgia	Putnam	13237	2.74	2.26	3.61	-4.16	-10.55	3.12
Georgia	Quitman	13239	3.40	2.57	5.22	-4.29	-11.71	2.75
Georgia	Rabun	13241	3.88	2.59	5.32	-2.41	-9.96	6.49
Georgia	Randolph	13243	3.72	2.91	5.15	-7.34	-14.67	-1.38
Georgia	Richmond	13245	6.03	4.44	7.75	-2.21	-9.37	4.04
Georgia	Rockdale	13247	2.65	2.17	3.34	-5.59	-12.72	-0.20
Georgia	Schley	13249	3.31	2.11	4.22	-6.38	-14.86	3.60
Georgia	Screven	13251	3.13	2.45	4.06	-1.99	-8.18	3.98
Georgia	Seminole	13253	4.25	2.78	5.54	-7.57	-13.77	4.95
Georgia	Spalding	13255	3.82	2.51	4.63	-9.55	-15.91	-3.84
Georgia	Stephens	13257	3.89	2.77	6.19	-1.11	-8.18	8.93
Georgia	Stewart	13259	3.47	2.78	4.39	-7.68	-14.19	-1.74
Georgia	Sumter	13261	2.84	2.08	3.62	-4.68	-11.44	1.20
Georgia	Talbot	13263	3.00	2.38	4.01	-6.60	-13.60	1.60
Georgia	Taliaferro	13265	3.69	2.85	5.03	-0.50	-5.99	7.91
Georgia	Tattnall	13267	4.08	3.06	5.07	-3.67	-10.68	2.03
Georgia	Taylor	13269	3.78	3.09	5.05	-5.57	-12.66	0.95
Georgia	Telfair	13271	2.67	1.77	3.98	-3.29	-8.79	3.11
Georgia	Terrell	13273	3.05	2.41	4.92	-8.72	-13.92	-2.89
Georgia	Thomas	13275	4.13	3.23	5.47	-4.30	-10.70	1.86
Georgia	Tift	13277	4.28	3.03	5.19	-2.67	-9.15	5.81
Georgia	Toombs	13279	3.70	2.78	4.65	-1.98	-9.24	4.49
Georgia	Towns	13281	*	*	*	*	*	*
Georgia	Treutlen	13283	3.33	2.30	4.32	-3.35	-11.25	3.81
Georgia	Troup	13285	3.46	2.20	4.19	-7.30	-16.34	-1.43
Georgia	Turner	13287	4.14	2.88	5.54	-2.51	-11.95	5.08

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State	County	FIPS	2017 Rate per 100,000 rate	95% CI		2013-2017 AAPC AAPC	95% CI	
Georgia	Twiggs	13289	3.60	2.39	4.79	-6.19	-12.27	-0.45
Georgia	Union	13291	4.52	2.71	6.15	-3.65	-11.53	7.03
Georgia	Upson	13293	3.57	2.73	4.43	-7.20	-13.72	-0.28
Georgia	Walker	13295	4.47	3.44	6.58	-0.09	-7.80	8.21
Georgia	Walton	13297	2.53	2.01	3.12	-6.82	-12.96	0.85
Georgia	Ware	13299	4.77	3.65	6.13	-3.00	-8.56	4.31
Georgia	Warren	13301	4.42	3.24	5.96	-2.96	-9.16	4.45
Georgia	Washington	13303	3.35	2.43	4.83	-3.23	-8.11	3.12
Georgia	Wayne	13305	5.85	4.54	7.82	-3.37	-9.49	5.23
Georgia	Webster	13307	3.96	2.31	5.36	-8.08	-15.85	-0.89
Georgia	Wheeler	13309	3.32	2.47	4.25	-5.78	-11.51	0.10
Georgia	White	13311	3.97	2.57	5.69	-2.41	-11.25	6.72
Georgia	Whitfield	13313	3.86	2.98	5.20	-2.38	-9.15	6.55
Georgia	Wilcox	13315	3.59	2.63	4.96	-3.32	-8.66	2.75
Georgia	Wilkes	13317	*	*	*	*	*	*
Georgia	Wilkinson	13319	4.15	2.76	5.45	-3.48	-10.45	2.68
Georgia	Worth	13321	4.89	4.07	6.41	-4.12	-10.03	4.14
Hawaii	Hawaii	15001	5.20	3.95	7.08	-4.25	-13.80	5.46
Hawaii	Honolulu	15003	2.78	2.09	3.61	-4.91	-11.28	2.37
Hawaii	Kauai	15007	*	*	*	*	*	*
Hawaii	Maui	15009	4.42	3.20	5.89	-4.99	-12.79	4.83
Idaho	Ada	16001	3.89	3.10	4.93	-9.25	-16.01	-2.30
Idaho	Adams	16003	4.21	2.64	5.54	-7.93	-15.14	-1.35
Idaho	Bannock	16005	3.45	2.11	5.21	-1.03	-11.41	11.34
Idaho	Bear Lake	16007	4.03	2.66	6.15	-1.83	-9.74	5.39
Idaho	Benewah	16009	5.03	3.56	6.63	-7.46	-13.09	0.35
Idaho	Bingham	16011	3.30	2.42	4.24	-2.75	-9.82	4.84
Idaho	Blaine	16013	3.27	2.36	4.23	-5.84	-11.70	-0.26
Idaho	Boise	16015	4.75	3.67	6.19	-8.70	-15.46	-0.55
Idaho	Bonner	16017	5.83	4.11	7.56	-6.72	-13.90	0.49
Idaho	Bonneville	16019	3.44	2.77	4.70	1.57	-6.16	9.93
Idaho	Boundary	16021	*	*	*	*	*	*
Idaho	Butte	16023	3.11	2.35	4.28	-4.64	-12.99	2.74
Idaho	Camas	16025	4.97	2.84	6.59	-6.10	-14.79	3.75
Idaho	Canyon	16027	5.44	4.27	7.19	-6.42	-14.18	2.22
Idaho	Caribou	16029	2.76	1.93	3.62	-0.01	-8.04	8.26
Idaho	Cassia	16031	4.09	3.03	6.10	-4.70	-14.59	3.21
Idaho	Clark	16033	3.48	2.34	4.54	-6.15	-12.93	1.19
Idaho	Clearwater	16035	4.14	3.01	5.77	-6.74	-13.29	1.99
Idaho	Custer	16037	4.05	2.77	5.33	-6.89	-13.29	0.34

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			2017 Rate per 100,000			2013-2017 AAPC		
State	**County**	**FIPS**	**rate**	**95% CI**		**AAPC**	**95% CI**	
Idaho	Elmore	16039	4.37	3.29	5.99	-8.75	-14.98	-1.07
Idaho	Franklin	16041	2.86	2.01	3.70	-2.53	-9.50	7.11
Idaho	Fremont	16043	2.47	1.85	3.32	-3.41	-9.02	4.37
Idaho	Gem	16045	4.00	2.71	6.11	-8.14	-17.10	0.35
Idaho	Gooding	16047	4.02	2.33	6.22	-5.52	-13.70	3.88
Idaho	Idaho	16049	4.83	3.73	6.49	-8.46	-15.63	-1.75
Idaho	Jefferson	16051	2.39	1.51	3.49	0.35	-8.94	8.80
Idaho	Jerome	16053	4.38	2.87	6.78	-4.55	-13.56	5.22
Idaho	Kootenai	16055	5.65	4.11	7.32	-7.95	-15.60	-0.94
Idaho	Latah	16057	3.66	2.89	4.98	-7.26	-13.78	1.47
Idaho	Lemhi	16059	2.57	1.89	3.94	-7.25	-14.60	1.30
Idaho	Lewis	16061	*	*	*	*	*	*
Idaho	Lincoln	16063	*	*	*	*	*	*
Idaho	Madison	16065	2.33	1.52	3.09	0.41	-11.68	8.60
Idaho	Minidoka	16067	2.93	2.05	4.42	-6.36	-17.33	2.67
Idaho	Nez Perce	16069	4.41	3.30	5.75	-6.60	-14.17	0.38
Idaho	Oneida	16071	2.91	1.95	4.39	-1.74	-9.84	8.04
Idaho	Owyhee	16073	4.49	2.87	6.33	-6.88	-14.33	2.12
Idaho	Payette	16075	*	*	*	*	*	*
Idaho	Power	16077	3.11	2.22	4.33	-1.11	-8.49	6.43
Idaho	Shoshone	16079	6.54	4.83	8.28	-6.89	-12.45	2.34
Idaho	Teton	16081	2.36	1.74	3.64	-0.61	-8.33	10.44
Idaho	Twin Falls	16083	4.26	3.19	6.59	-4.83	-12.60	4.45
Idaho	Valley	16085	4.11	3.31	5.29	-9.82	-17.58	-2.39
Idaho	Washington	16087	4.65	3.00	6.60	-7.29	-17.45	1.51
Illinois	Adams	17001	2.08	1.65	2.84	-4.81	-11.27	3.31
Illinois	Alexander	17003	4.26	3.12	5.78	-5.96	-12.62	1.60
Illinois	Bond	17005	2.47	1.51	3.71	-7.41	-16.89	4.47
Illinois	Boone	17007	1.23	0.85	1.65	-5.94	-14.47	0.37
Illinois	Brown	17009	3.34	2.11	4.38	-8.15	-16.27	0.11
Illinois	Bureau	17011	2.07	1.57	2.89	-2.46	-11.21	4.29
Illinois	Calhoun	17013	*	*	*	*	*	*
Illinois	Carroll	17015	1.70	1.16	2.33	-4.32	-11.31	3.85
Illinois	Cass	17017	3.32	2.49	4.65	-7.50	-15.15	0.62
Illinois	Champaign	17019	3.36	2.47	4.42	-3.02	-11.95	7.01
Illinois	Christian	17021	1.88	1.39	2.89	-7.42	-16.44	1.63
Illinois	Clark	17023	3.10	2.15	4.12	-3.45	-10.47	4.05
Illinois	Clay	17025	2.28	1.74	3.57	-1.34	-9.85	6.97
Illinois	Clinton	17027	1.77	1.43	2.32	-3.94	-10.29	3.28
Illinois	Coles	17029	3.26	2.48	4.59	-3.88	-9.83	4.53

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			2017 Rate per 100,000			2013-2017 AAPC		
State	**County**	**FIPS**	**rate**	**95% CI**		**AAPC**	**95% CI**	
Illinois	Cook	17031	2.09	1.82	2.36	-4.33	-7.93	-0.39
Illinois	Crawford	17033	3.11	2.38	4.42	-2.91	-10.09	8.44
Illinois	Cumberland	17035	2.47	1.71	3.68	-4.42	-13.12	4.46
Illinois	DeKalb	17037	1.40	0.91	1.89	-4.97	-11.54	2.14
Illinois	De Witt	17039	1.57	1.22	2.17	-5.70	-15.21	3.20
Illinois	Douglas	17041	2.36	1.66	3.50	-1.24	-9.82	6.70
Illinois	DuPage	17043	0.93	0.63	1.23	-3.63	-13.60	3.27
Illinois	Edgar	17045	3.99	2.68	5.63	0.08	-6.78	9.43
Illinois	Edwards	17047	2.90	2.12	3.87	-4.20	-14.19	5.88
Illinois	Effingham	17049	2.15	1.64	3.03	-2.77	-10.54	4.20
Illinois	Fayette	17051	2.10	1.39	3.34	-6.27	-12.16	1.34
Illinois	Ford	17053	2.90	2.01	4.08	-5.06	-13.05	3.78
Illinois	Franklin	17055	4.34	2.97	6.70	-0.18	-7.65	9.60
Illinois	Fulton	17057	2.27	1.81	3.19	-6.74	-13.79	0.62
Illinois	Gallatin	17059	4.01	3.00	5.86	-3.62	-10.95	7.33
Illinois	Greene	17061	2.88	2.26	3.83	-3.47	-12.42	6.74
Illinois	Grundy	17063	1.53	1.19	2.20	-3.07	-11.12	5.17
Illinois	Hamilton	17065	3.12	2.19	4.58	-2.04	-9.01	6.19
Illinois	Hancock	17067	2.37	1.57	3.67	-5.99	-13.12	1.79
Illinois	Hardin	17069	3.75	2.48	5.17	-1.67	-8.72	6.75
Illinois	Henderson	17071	2.96	2.30	4.64	-3.86	-11.97	6.59
Illinois	Henry	17073	2.67	1.89	3.67	-4.39	-12.23	2.92
Illinois	Iroquois	17075	1.70	1.07	2.64	-7.15	-15.93	2.95
Illinois	Jackson	17077	3.30	2.61	3.96	-3.16	-8.83	2.74
Illinois	Jasper	17079	3.01	2.13	4.23	-1.94	-7.53	6.19
Illinois	Jefferson	17081	2.90	1.98	4.32	-2.06	-10.69	4.82
Illinois	Jersey	17083	2.40	1.72	3.65	-4.12	-9.97	6.36
Illinois	Jo Daviess	17085	1.83	1.27	2.82	-1.87	-8.52	4.97
Illinois	Johnson	17087	3.59	2.72	4.83	-5.39	-13.41	1.61
Illinois	Kane	17089	1.19	0.95	1.49	-6.59	-12.58	0.43
Illinois	Kankakee	17091	1.89	1.36	2.70	-5.18	-11.22	3.27
Illinois	Kendall	17093	1.24	0.96	1.72	-4.79	-10.98	2.96
Illinois	Knox	17095	3.30	2.53	4.37	-6.01	-13.37	0.05
Illinois	Lake	17097	1.39	1.08	1.86	-7.93	-14.32	-1.97
Illinois	La Salle	17099	1.67	1.22	2.27	-4.99	-10.28	2.52
Illinois	Lawrence	17101	*	*	*	*	*	*
Illinois	Lee	17103	2.48	1.81	3.48	-4.74	-12.18	2.57
Illinois	Livingston	17105	2.74	1.80	3.84	-4.73	-13.66	4.35
Illinois	Logan	17107	2.62	2.06	3.45	-7.51	-14.98	-0.63
Illinois	McDonough	17109	2.38	1.59	3.41	-6.47	-12.97	1.15

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			2017 Rate per 100,000			2013-2017 AAPC		
State	**County**	**FIPS**	**rate**	**95% CI**		**AAPC**	**95% CI**	
Illinois	McHenry	17111	1.33	0.85	1.74	-6.57	-17.17	0.14
Illinois	McLean	17113	2.22	1.75	2.81	-3.75	-10.15	3.51
Illinois	Macon	17115	2.00	1.68	2.47	-7.00	-12.92	-0.83
Illinois	Macoupin	17117	3.18	2.42	4.30	-6.33	-13.40	0.87
Illinois	Madison	17119	2.46	1.96	3.26	-5.26	-12.68	0.22
Illinois	Marion	17121	2.66	1.90	3.67	-3.43	-10.44	4.22
Illinois	Marshall	17123	1.70	1.21	2.27	-2.21	-10.89	6.93
Illinois	Mason	17125	3.14	2.33	4.59	-8.19	-15.21	-0.51
Illinois	Massac	17127	3.66	2.52	5.00	-4.66	-12.57	3.07
Illinois	Menard	17129	3.09	2.21	4.09	-8.07	-16.02	-0.05
Illinois	Mercer	17131	2.52	1.88	3.42	-4.15	-11.41	5.49
Illinois	Monroe	17133	2.49	1.88	3.68	-3.26	-9.56	5.82
Illinois	Montgomery	17135	2.36	1.77	3.34	-6.22	-13.76	2.95
Illinois	Morgan	17137	3.31	2.17	4.85	-5.43	-11.95	5.38
Illinois	Moultrie	17139	2.26	1.61	3.13	-5.97	-13.96	1.94
Illinois	Ogle	17141	1.50	1.04	1.97	-4.68	-12.37	4.81
Illinois	Peoria	17143	3.45	2.78	4.27	-2.68	-9.36	4.06
Illinois	Perry	17145	3.20	2.33	4.80	-2.63	-9.38	6.27
Illinois	Piatt	17147	2.21	1.53	3.15	-5.50	-13.47	2.85
Illinois	Pike	17149	3.03	2.10	4.23	-2.05	-10.71	5.69
Illinois	Pope	17151	4.47	3.03	6.14	-2.56	-10.59	3.64
Illinois	Pulaski	17153	4.14	2.81	5.43	-4.15	-9.58	3.48
Illinois	Putnam	17155	1.80	1.21	2.70	-0.83	-12.58	12.31
Illinois	Randolph	17157	4.12	2.87	5.36	-2.02	-8.83	4.92
Illinois	Richland	17159	2.75	1.83	3.98	-3.13	-10.15	8.40
Illinois	Rock Island	17161	2.39	1.90	3.34	-3.72	-9.97	3.01
Illinois	St. Clair	17163	2.93	2.31	3.69	-1.12	-7.44	4.71
Illinois	Saline	17165	4.28	3.08	5.63	-3.54	-8.72	2.62
Illinois	Sangamon	17167	3.44	2.43	4.60	-6.75	-12.14	0.27
Illinois	Schuyler	17169	2.91	2.04	4.29	-5.27	-11.52	1.26
Illinois	Scott	17171	3.37	2.36	5.62	-3.85	-12.17	8.30
Illinois	Shelby	17173	1.88	1.58	2.39	-6.98	-12.96	3.27
Illinois	Stark	17175	*	*	*	*	*	*
Illinois	Stephenson	17177	2.28	1.74	3.49	-3.87	-9.96	5.35
Illinois	Tazewell	17179	1.81	1.30	2.40	-4.83	-12.73	2.44
Illinois	Union	17181	3.26	2.32	4.63	-3.00	-9.29	4.33
Illinois	Vermilion	17183	4.06	3.25	5.18	-6.49	-14.74	-0.10
Illinois	Wabash	17185	3.41	2.44	4.93	-3.44	-11.94	4.61
Illinois	Warren	17187	*	*	*	*	*	*
Illinois	Washington	17189	2.44	1.85	3.10	-1.79	-7.93	6.06

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State	County	FIPS	2017 Rate per 100,000 rate	95% CI		2013-2017 AAPC AAPC	95% CI	
Illinois	Wayne	17191	2.77	2.10	3.68	-2.27	-10.93	6.82
Illinois	White	17193	*	*	*	*	*	*
Illinois	Whiteside	17195	2.58	1.93	3.29	-4.49	-11.80	2.65
Illinois	Will	17197	1.24	0.97	1.63	-4.38	-10.11	1.38
Illinois	Williamson	17199	2.86	2.20	3.71	0.22	-7.56	8.79
Illinois	Winnebago	17201	1.65	1.28	2.04	-9.17	-14.93	-2.96
Illinois	Woodford	17203	2.03	1.49	2.74	-2.66	-10.70	7.88
Indiana	Adams	18001	2.85	1.56	4.05	0.65	-9.02	10.47
Indiana	Allen	18003	3.33	2.70	4.27	1.49	-4.08	7.87
Indiana	Bartholomew	18005	2.52	1.85	3.77	-0.81	-10.02	7.48
Indiana	Benton	18007	2.04	1.29	2.66	-6.34	-16.43	1.69
Indiana	Blackford	18009	3.53	2.50	4.97	1.36	-8.50	10.10
Indiana	Boone	18011	2.15	1.50	3.00	-1.35	-8.98	4.80
Indiana	Brown	18013	2.67	1.96	3.70	-0.97	-8.06	7.86
Indiana	Carroll	18015	2.49	1.85	3.47	-5.44	-12.93	1.79
Indiana	Cass	18017	2.61	2.03	3.43	-7.51	-14.87	0.16
Indiana	Clark	18019	3.23	2.52	4.21	2.29	-4.61	10.50
Indiana	Clay	18021	2.61	1.99	4.12	-2.09	-8.05	6.80
Indiana	Clinton	18023	2.52	1.87	3.37	-3.82	-10.78	5.11
Indiana	Crawford	18025	2.83	1.71	4.03	-2.94	-10.42	6.76
Indiana	Daviess	18027	2.98	2.16	4.07	-2.77	-10.24	5.45
Indiana	Dearborn	18029	2.46	1.91	3.30	-3.09	-10.17	4.13
Indiana	Decatur	18031	2.97	1.94	4.19	-1.84	-7.99	7.79
Indiana	DeKalb	18033	2.27	1.58	2.95	-0.63	-7.68	11.27
Indiana	Delaware	18035	4.19	2.94	5.52	2.40	-4.94	10.80
Indiana	Dubois	18037	2.36	1.88	2.95	0.28	-8.12	6.77
Indiana	Elkhart	18039	2.46	1.88	3.06	-1.76	-9.00	5.16
Indiana	Fayette	18041	4.27	2.85	5.61	-4.47	-12.51	2.04
Indiana	Floyd	18043	3.57	2.48	5.47	3.28	-8.51	12.10
Indiana	Fountain	18045	2.27	1.40	3.12	-4.22	-10.96	5.96
Indiana	Franklin	18047	3.47	2.46	4.71	-3.89	-10.00	2.85
Indiana	Fulton	18049	2.31	1.61	3.40	-3.91	-10.37	2.89
Indiana	Gibson	18051	*	*	*	*	*	*
Indiana	Grant	18053	2.85	2.31	3.58	-2.13	-7.96	5.03
Indiana	Greene	18055	2.87	2.21	3.87	-0.67	-7.02	7.95
Indiana	Hamilton	18057	1.53	1.20	2.06	-1.33	-8.55	7.38
Indiana	Hancock	18059	2.83	1.99	4.12	-1.90	-9.12	4.31
Indiana	Harrison	18061	2.83	1.86	3.94	0.13	-8.28	11.83
Indiana	Hendricks	18063	2.44	1.96	3.13	-2.44	-8.49	4.22
Indiana	Henry	18065	4.21	3.10	6.65	-3.07	-9.99	5.09

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			2017 Rate per 100,000			2013-2017 AAPC		
State	**County**	**FIPS**	**rate**	**95% CI**		**AAPC**	**95% CI**	
Indiana	Howard	18067	2.33	1.86	3.03	-5.84	-12.09	0.12
Indiana	Huntington	18069	2.08	1.59	2.76	0.30	-6.72	8.96
Indiana	Jackson	18071	3.56	2.68	4.67	0.75	-6.68	9.17
Indiana	Jasper	18073	1.65	1.28	2.56	-6.87	-15.12	0.59
Indiana	Jay	18075	2.61	1.83	3.61	0.63	-7.83	8.24
Indiana	Jefferson	18077	3.72	2.78	5.32	0.34	-7.59	7.62
Indiana	Jennings	18079	3.24	2.33	4.33	0.83	-6.39	9.94
Indiana	Johnson	18081	2.81	2.08	3.73	1.06	-7.32	11.35
Indiana	Knox	18083	3.99	2.84	5.70	-3.55	-11.03	4.39
Indiana	Kosciusko	18085	2.32	1.87	3.11	1.73	-6.28	10.08
Indiana	LaGrange	18087	2.38	1.69	3.47	-1.95	-10.00	8.21
Indiana	Lake	18089	2.27	1.89	2.80	-7.17	-13.03	-1.18
Indiana	LaPorte	18091	3.45	2.67	4.63	-3.95	-12.26	8.08
Indiana	Lawrence	18093	2.48	1.57	3.40	0.28	-6.55	8.65
Indiana	Madison	18095	2.88	2.18	3.62	-0.98	-8.33	6.34
Indiana	Marion	18097	6.41	5.50	7.33	-2.01	-6.13	2.05
Indiana	Marshall	18099	2.11	1.46	3.07	-2.26	-9.57	8.39
Indiana	Martin	18101	3.43	2.62	4.44	-1.87	-8.71	8.03
Indiana	Miami	18103	2.49	1.95	3.34	-4.57	-11.01	3.48
Indiana	Monroe	18105	2.21	1.60	3.22	-2.85	-9.27	3.59
Indiana	Montgomery	18107	1.99	1.47	2.70	-0.03	-8.46	8.28
Indiana	Morgan	18109	2.76	2.18	3.66	0.05	-7.27	8.75
Indiana	Newton	18111	2.08	1.42	2.90	-8.55	-19.16	1.86
Indiana	Noble	18113	2.57	1.88	3.33	1.67	-6.34	11.06
Indiana	Ohio	18115	*	*	*	*	*	*
Indiana	Orange	18117	2.47	1.69	3.22	-1.18	-9.36	7.06
Indiana	Owen	18119	3.07	2.31	4.26	-2.39	-10.69	4.51
Indiana	Parke	18121	2.50	1.79	3.32	-0.57	-8.92	7.34
Indiana	Perry	18123	2.25	1.57	3.16	-0.17	-7.20	7.20
Indiana	Pike	18125	*	*	*	*	*	*
Indiana	Porter	18127	2.16	1.68	3.13	-5.01	-12.87	3.19
Indiana	Posey	18129	2.75	1.74	3.95	-1.94	-8.87	6.26
Indiana	Pulaski	18131	2.22	1.66	3.06	-6.32	-13.91	2.46
Indiana	Putnam	18133	2.50	1.73	3.34	-1.63	-10.63	5.89
Indiana	Randolph	18135	3.22	1.92	4.63	-0.38	-6.84	7.22
Indiana	Ripley	18137	2.79	1.90	3.85	-0.40	-8.09	6.81
Indiana	Rush	18139	3.36	2.31	4.71	-4.18	-11.05	7.05
Indiana	St. Joseph	18141	3.05	2.40	4.01	-5.38	-11.19	1.57
Indiana	Scott	18143	*	*	*	*	*	*
Indiana	Shelby	18145	*	*	*	*	*	*

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			2017 Rate per 100,000			2013-2017 AAPC		
State	**County**	**FIPS**	**rate**	**95% CI**		**AAPC**	**95% CI**	
Indiana	Spencer	18147	2.14	1.33	3.31	0.13	-10.17	10.00
Indiana	Starke	18149	*	*	*	*	*	*
Indiana	Steuben	18151	2.80	2.06	4.06	-3.25	-9.59	6.10
Indiana	Sullivan	18153	4.08	3.10	5.76	-3.52	-10.73	5.57
Indiana	Switzerland	18155	3.09	2.33	4.30	2.34	-5.71	13.07
Indiana	Tippecanoe	18157	2.00	1.44	2.84	-3.29	-10.30	3.87
Indiana	Tipton	18159	*	*	*	*	*	*
Indiana	Union	18161	4.21	2.63	5.90	-4.17	-13.42	5.96
Indiana	Vanderburgh	18163	5.79	4.42	7.23	1.14	-6.28	11.54
Indiana	Vermillion	18165	2.70	2.01	3.49	-3.57	-12.72	4.26
Indiana	Vigo	18167	3.38	2.63	4.57	-3.68	-10.23	3.58
Indiana	Wabash	18169	2.31	1.62	3.45	-2.11	-10.92	5.59
Indiana	Warren	18171	2.37	1.42	3.78	-7.58	-17.83	3.35
Indiana	Warrick	18173	1.81	1.41	2.57	0.37	-7.65	8.64
Indiana	Washington	18175	3.09	2.51	4.11	0.84	-6.07	9.80
Indiana	Wayne	18177	4.43	3.09	5.70	-2.19	-9.98	5.69
Indiana	Wells	18179	2.40	1.75	3.40	-0.10	-8.08	11.57
Indiana	White	18181	2.39	1.62	3.17	-7.18	-14.41	2.43
Indiana	Whitley	18183	2.56	1.62	3.50	-0.33	-7.39	9.84
Iowa	Adair	19001	2.59	1.96	3.69	-3.67	-9.89	3.72
Iowa	Adams	19003	2.43	1.72	3.52	-3.13	-11.87	6.47
Iowa	Allamakee	19005	*	*	*	*	*	*
Iowa	Appanoose	19007	3.37	2.36	4.86	-5.97	-14.49	1.50
Iowa	Audubon	19009	2.00	1.40	2.80	-5.53	-15.30	3.10
Iowa	Benton	19011	2.17	1.57	3.15	-4.86	-11.56	3.40
Iowa	Black Hawk	19013	2.73	1.97	3.46	-1.40	-9.24	5.75
Iowa	Boone	19015	1.96	1.37	3.01	-4.45	-15.95	4.78
Iowa	Bremer	19017	1.92	1.39	2.89	-3.14	-11.22	6.02
Iowa	Buchanan	19019	2.26	1.40	3.09	-2.84	-11.95	4.43
Iowa	Buena Vista	19021	2.17	1.64	2.94	-4.45	-12.59	3.38
Iowa	Butler	19023	1.97	1.39	2.93	-3.41	-14.39	4.23
Iowa	Calhoun	19025	1.61	1.15	2.28	-4.94	-12.57	2.16
Iowa	Carroll	19027	1.94	1.43	3.00	-5.34	-15.16	5.45
Iowa	Cass	19029	3.00	2.21	4.22	-6.07	-14.82	2.25
Iowa	Cedar	19031	2.00	1.53	3.14	-5.60	-13.35	0.97
Iowa	Cerro Gordo	19033	2.43	1.86	3.30	-4.97	-12.06	4.53
Iowa	Cherokee	19035	2.40	1.65	3.73	-4.82	-13.18	4.44
Iowa	Chickasaw	19037	2.03	1.59	2.58	-4.29	-9.36	1.77
Iowa	Clarke	19039	*	*	*	*	*	*
Iowa	Clay	19041	2.46	1.86	3.28	-5.33	-12.47	1.82

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State	**County**	**FIPS**	**rate**	**95% CI**		**AAPC**	**95% CI**	
Iowa	Clayton	19043	2.21	1.42	3.01	-1.83	-8.66	6.88
Iowa	Clinton	19045	2.18	1.52	3.01	-6.09	-12.77	0.72
Iowa	Crawford	19047	2.01	1.56	2.64	-3.85	-10.62	2.91
Iowa	Dallas	19049	1.85	1.37	2.81	-7.08	-13.81	2.62
Iowa	Davis	19051	*	*	*	*	*	*
Iowa	Decatur	19053	3.01	2.18	4.11	-4.57	-12.99	2.59
Iowa	Delaware	19055	2.08	1.49	2.81	-1.54	-9.03	5.40
Iowa	Des Moines	19057	3.19	2.38	4.59	-2.07	-10.59	7.29
Iowa	Dickinson	19059	2.14	1.47	2.77	-7.65	-16.42	0.96
Iowa	Dubuque	19061	1.68	1.27	2.40	-2.59	-9.28	5.99
Iowa	Emmet	19063	1.89	1.39	2.49	-6.51	-14.02	2.29
Iowa	Fayette	19065	1.94	1.40	3.01	-1.44	-7.71	5.58
Iowa	Floyd	19067	1.85	1.24	2.54	-4.17	-11.12	4.09
Iowa	Franklin	19069	2.49	1.76	3.26	-4.70	-12.52	5.84
Iowa	Fremont	19071	3.44	2.32	5.31	-0.63	-8.99	7.04
Iowa	Greene	19073	1.82	1.30	2.77	-4.99	-16.30	3.96
Iowa	Grundy	19075	1.73	1.15	2.65	-3.71	-11.99	6.40
Iowa	Guthrie	19077	2.43	1.55	3.04	-5.76	-13.89	3.84
Iowa	Hamilton	19079	2.61	1.86	3.41	-1.62	-10.90	6.96
Iowa	Hancock	19081	2.93	2.09	4.16	-6.95	-15.78	2.21
Iowa	Hardin	19083	2.24	1.67	3.01	-4.56	-13.73	6.27
Iowa	Harrison	19085	2.27	1.56	3.25	-5.12	-12.52	3.51
Iowa	Henry	19087	*	*	*	*	*	*
Iowa	Howard	19089	2.15	1.29	3.16	-5.79	-16.22	6.28
Iowa	Humboldt	19091	2.44	1.60	3.59	-6.73	-14.62	3.17
Iowa	Ida	19093	*	*	*	*	*	*
Iowa	Iowa	19095	2.34	1.68	3.58	-3.99	-11.83	3.02
Iowa	Jackson	19097	1.84	1.18	2.76	-2.76	-12.42	6.84
Iowa	Jasper	19099	2.41	1.65	4.03	-8.19	-14.93	1.87
Iowa	Jefferson	19101	2.64	2.00	3.84	-4.40	-12.29	3.39
Iowa	Johnson	19103	3.55	2.58	4.54	-2.93	-9.51	4.24
Iowa	Jones	19105	2.00	1.35	3.12	-4.06	-11.96	3.94
Iowa	Keokuk	19107	2.65	1.67	3.99	-3.48	-11.80	6.16
Iowa	Kossuth	19109	1.75	1.30	3.04	-6.09	-15.21	3.30
Iowa	Lee	19111	3.97	2.63	5.05	-8.07	-14.55	-0.73
Iowa	Linn	19113	2.37	1.95	2.95	-5.41	-11.23	0.67
Iowa	Louisa	19115	3.22	2.05	4.58	-5.02	-12.79	2.23
Iowa	Lucas	19117	2.69	1.89	3.68	-5.76	-13.98	2.48
Iowa	Lyon	19119	1.98	1.45	3.14	-7.06	-13.98	2.27
Iowa	Madison	19121	2.42	1.70	3.45	-3.71	-10.72	5.08

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State	County	FIPS	2017 Rate per 100,000 rate	95% CI		2013-2017 AAPC AAPC	95% CI	
Iowa	Mahaska	19123	2.73	1.70	3.79	-3.24	-15.23	3.96
Iowa	Marion	19125	2.96	2.19	4.16	-6.56	-15.09	0.26
Iowa	Marshall	19127	3.51	2.70	5.63	-7.54	-17.23	6.23
Iowa	Mills	19129	3.04	2.22	4.37	-2.20	-10.20	7.22
Iowa	Mitchell	19131	2.07	1.32	3.29	-4.80	-14.79	4.42
Iowa	Monona	19133	2.55	1.82	3.62	-6.82	-15.85	2.17
Iowa	Monroe	19135	3.45	2.61	4.20	-6.78	-14.41	1.73
Iowa	Montgomery	19137	3.05	2.26	4.79	-3.75	-9.99	3.85
Iowa	Muscatine	19139	2.94	1.99	3.79	-4.85	-10.72	3.60
Iowa	O'Brien	19141	2.10	1.65	2.77	-5.03	-10.93	2.26
Iowa	Osceola	19143	1.97	1.36	2.61	-5.68	-13.78	1.57
Iowa	Page	19145	3.08	2.33	5.19	-2.98	-9.98	5.77
Iowa	Palo Alto	19147	2.15	1.47	3.12	-8.52	-14.33	-0.62
Iowa	Plymouth	19149	2.09	1.42	3.30	-4.56	-13.72	4.36
Iowa	Pocahontas	19151	2.07	1.50	2.90	-4.24	-12.42	3.84
Iowa	Polk	19153	3.81	3.10	4.88	-6.93	-13.19	0.43
Iowa	Pottawattamie	19155	4.10	3.14	5.20	-4.09	-12.32	3.51
Iowa	Poweshiek	19157	2.45	1.45	3.70	-5.30	-14.12	3.45
Iowa	Ringgold	19159	2.61	1.94	3.90	-3.16	-12.53	4.35
Iowa	Sac	19161	2.17	1.60	3.41	-5.72	-13.11	2.67
Iowa	Scott	19163	3.22	2.38	4.26	-6.02	-12.72	2.24
Iowa	Shelby	19165	2.36	1.72	3.66	-4.46	-13.40	5.49
Iowa	Sioux	19167	1.76	1.24	2.50	-4.73	-11.50	2.98
Iowa	Story	19169	2.08	1.57	3.02	-3.02	-12.33	7.33
Iowa	Tama	19171	2.32	1.68	3.42	-4.90	-12.31	5.42
Iowa	Taylor	19173	3.31	2.30	4.87	-3.99	-11.88	6.00
Iowa	Union	19175	2.86	2.12	3.99	-2.57	-11.49	3.96
Iowa	Van Buren	19177	3.40	2.33	4.86	-5.94	-13.69	0.52
Iowa	Wapello	19179	3.03	1.94	4.17	-6.59	-14.04	1.87
Iowa	Warren	19181	2.65	2.06	4.05	-6.54	-14.51	2.39
Iowa	Washington	19183	3.51	2.41	4.73	-4.36	-12.92	3.21
Iowa	Wayne	19185	3.37	2.30	5.08	-6.12	-13.13	1.65
Iowa	Webster	19187	2.39	1.73	3.47	-3.92	-10.96	4.55
Iowa	Winnebago	19189	2.62	2.11	3.73	-6.73	-14.46	1.31
Iowa	Winneshiek	19191	*	*	*	*	*	*
Iowa	Woodbury	19193	4.17	3.21	5.30	-4.99	-11.16	2.00
Iowa	Worth	19195	3.20	2.21	4.35	-6.39	-17.78	3.28
Iowa	Wright	19197	*	*	*	*	*	*
Kansas	Allen	20001	2.62	2.13	3.80	-2.12	-10.34	5.86
Kansas	Anderson	20003	2.81	1.98	3.90	-0.51	-9.09	7.24

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State	County	FIPS	2017 Rate per 100,000 rate	95% CI		2013-2017 AAPC AAPC	95% CI	
Kansas	Atchison	20005	3.63	2.58	4.71	-2.87	-9.71	4.09
Kansas	Barber	20007	4.12	3.03	6.26	1.91	-5.04	10.09
Kansas	Barton	20009	4.70	3.12	7.05	0.67	-8.96	10.51
Kansas	Bourbon	20011	3.38	2.39	4.68	-3.53	-10.65	5.17
Kansas	Brown	20013	*	*	*	*	*	*
Kansas	Butler	20015	4.40	3.30	5.94	1.76	-5.25	8.20
Kansas	Chase	20017	4.05	2.69	5.82	2.92	-6.37	14.17
Kansas	Chautauqua	20019	7.85	5.51	11.16	2.29	-5.97	11.85
Kansas	Cherokee	20021	4.68	3.46	6.34	-5.62	-13.37	1.54
Kansas	Cheyenne	20023	3.49	2.43	5.47	-0.63	-11.13	10.71
Kansas	Clark	20025	3.56	2.53	5.89	-0.25	-8.25	7.92
Kansas	Clay	20027	2.99	2.11	5.05	-0.88	-8.23	8.20
Kansas	Cloud	20029	2.75	2.07	4.68	-1.03	-8.15	6.57
Kansas	Coffey	20031	3.23	2.26	5.12	-1.39	-11.61	6.10
Kansas	Comanche	20033	4.18	2.95	5.99	-1.82	-11.22	8.88
Kansas	Cowley	20035	7.41	4.24	9.96	3.88	-3.55	11.30
Kansas	Crawford	20037	3.66	2.55	5.34	-2.94	-9.60	5.31
Kansas	Decatur	20039	*	*	*	*	*	*
Kansas	Dickinson	20041	4.14	2.63	5.82	3.10	-5.13	13.16
Kansas	Doniphan	20043	3.09	2.10	4.51	-2.16	-9.83	6.56
Kansas	Douglas	20045	3.03	2.29	4.09	-2.24	-8.47	4.94
Kansas	Edwards	20047	5.05	3.12	7.92	1.91	-7.15	12.10
Kansas	Elk	20049	*	*	*	*	*	*
Kansas	Ellis	20051	4.61	3.12	6.95	-0.02	-8.00	8.20
Kansas	Ellsworth	20053	*	*	*	*	*	*
Kansas	Finney	20055	3.24	2.45	4.88	-1.68	-9.87	13.71
Kansas	Ford	20057	6.18	4.77	8.92	-0.84	-8.66	10.96
Kansas	Franklin	20059	2.92	2.00	3.93	-1.96	-9.27	4.68
Kansas	Geary	20061	8.36	6.15	10.92	3.06	-6.93	12.14
Kansas	Gove	20063	*	*	*	*	*	*
Kansas	Graham	20065	4.36	2.80	5.91	2.40	-6.14	12.24
Kansas	Grant	20067	3.33	2.44	4.23	-2.53	-11.41	7.36
Kansas	Gray	20069	4.42	3.22	6.54	-2.25	-12.24	10.47
Kansas	Greeley	20071	4.88	3.35	6.74	-4.19	-10.90	3.98
Kansas	Greenwood	20073	3.43	2.71	4.41	-1.09	-7.63	6.75
Kansas	Hamilton	20075	6.28	3.34	8.93	-3.49	-12.04	6.28
Kansas	Harper	20077	*	*	*	*	*	*
Kansas	Harvey	20079	*	*	*	*	*	*
Kansas	Haskell	20081	4.07	2.51	5.99	-3.24	-14.96	7.23
Kansas	Hodgeman	20083	4.33	3.12	6.65	-1.19	-9.39	11.68

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State	**County**	**FIPS**	**rate**	**95% CI**		**AAPC**	**95% CI**	
Kansas	Jackson	20085	3.53	2.52	4.78	-0.71	-10.52	7.61
Kansas	Jefferson	20087	3.86	2.71	5.20	-3.53	-13.58	7.48
Kansas	Jewell	20089	2.90	1.90	3.69	-0.79	-9.47	6.38
Kansas	Johnson	20091	1.91	1.52	2.41	-3.59	-9.09	2.16
Kansas	Kearny	20093	3.70	2.41	5.51	-2.81	-12.43	6.92
Kansas	Kingman	20095	4.55	3.11	6.48	5.77	-4.18	16.58
Kansas	Kiowa	20097	4.42	3.46	6.25	2.09	-7.65	12.73
Kansas	Labette	20099	4.04	2.95	5.78	-0.33	-8.20	8.16
Kansas	Lane	20101	4.13	2.69	6.41	0.39	-10.59	15.47
Kansas	Leavenworth	20103	3.52	2.50	4.37	-3.28	-9.66	2.25
Kansas	Lincoln	20105	4.21	3.19	6.19	-1.52	-9.15	7.90
Kansas	Linn	20107	2.90	2.30	4.21	-3.45	-10.91	5.01
Kansas	Logan	20109	*	*	*	*	*	*
Kansas	Lyon	20111	3.40	2.57	4.84	-0.13	-7.85	10.86
Kansas	McPherson	20113	3.82	2.72	5.95	2.50	-5.62	14.98
Kansas	Marion	20115	3.55	2.68	4.89	4.23	-4.70	15.00
Kansas	Marshall	20117	3.31	2.48	4.64	-3.07	-8.73	4.74
Kansas	Meade	20119	5.59	3.85	7.39	-2.48	-11.76	8.11
Kansas	Miami	20121	2.65	1.94	3.61	-4.64	-13.86	3.00
Kansas	Mitchell	20123	*	*	*	*	*	*
Kansas	Montgomery	20125	5.26	4.00	7.96	-0.48	-9.76	6.00
Kansas	Morris	20127	5.85	4.27	7.91	1.98	-7.57	12.05
Kansas	Morton	20129	4.50	3.24	6.88	-4.07	-13.06	7.15
Kansas	Nemaha	20131	3.58	2.56	4.54	-1.51	-8.73	5.69
Kansas	Neosho	20133	3.09	2.08	4.60	0.03	-7.20	7.37
Kansas	Ness	20135	4.64	3.43	6.92	-0.39	-8.89	9.21
Kansas	Norton	20137	3.28	2.50	4.67	3.08	-8.03	12.68
Kansas	Osage	20139	3.46	2.14	4.95	-2.46	-9.98	7.74
Kansas	Osborne	20141	4.69	3.54	6.91	-2.53	-9.03	7.73
Kansas	Ottawa	20143	*	*	*	*	*	*
Kansas	Pawnee	20145	5.17	3.48	7.18	1.66	-7.53	9.30
Kansas	Phillips	20147	4.55	3.04	6.11	1.34	-5.54	9.09
Kansas	Pottawatomie	20149	3.33	2.42	4.69	-1.27	-9.16	7.07
Kansas	Pratt	20151	4.69	2.87	6.73	1.39	-4.60	10.84
Kansas	Rawlins	20153	4.08	2.48	5.59	-0.96	-11.65	12.74
Kansas	Reno	20155	5.47	4.12	7.17	2.77	-3.94	10.45
Kansas	Republic	20157	3.08	2.44	4.10	-5.37	-13.52	3.69
Kansas	Rice	20159	3.63	2.45	5.33	-1.44	-10.71	9.46
Kansas	Riley	20161	3.31	2.58	4.27	0.56	-6.03	8.48
Kansas	Rooks	20163	4.35	3.29	6.03	1.61	-5.30	12.71

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			2017 Rate per 100,000			2013-2017 AAPC		
State	**County**	**FIPS**	**rate**	**95% CI**		**AAPC**	**95% CI**	
Kansas	Rush	20165	*	*	*	*	*	*
Kansas	Russell	20167	5.32	3.49	7.80	-1.40	-12.08	8.50
Kansas	Saline	20169	3.67	2.48	4.95	2.51	-5.13	10.40
Kansas	Scott	20171	*	*	*	*	*	*
Kansas	Sedgwick	20173	6.14	5.04	7.34	5.91	0.93	11.88
Kansas	Seward	20175	4.07	2.97	5.91	-3.02	-14.38	7.59
Kansas	Shawnee	20177	3.84	2.88	4.78	-0.46	-10.12	6.02
Kansas	Sheridan	20179	5.17	3.36	6.89	2.21	-5.97	13.66
Kansas	Sherman	20181	4.07	2.84	6.52	-1.17	-11.52	13.49
Kansas	Smith	20183	4.12	3.14	5.64	-0.13	-6.44	7.64
Kansas	Stafford	20185	4.34	3.14	5.96	3.36	-5.06	11.76
Kansas	Stanton	20187	4.41	3.54	5.74	-2.76	-9.48	7.48
Kansas	Stevens	20189	4.17	3.16	5.43	-4.45	-12.95	4.98
Kansas	Sumner	20191	4.94	3.77	6.88	2.84	-3.98	9.61
Kansas	Thomas	20193	4.20	2.57	6.62	-0.14	-12.93	12.34
Kansas	Trego	20195	*	*	*	*	*	*
Kansas	Wabaunsee	20197	4.15	3.03	6.02	-0.85	-7.69	8.09
Kansas	Wallace	20199	4.26	2.93	5.85	-1.68	-14.89	7.40
Kansas	Washington	20201	2.99	2.06	4.56	-3.49	-10.56	4.29
Kansas	Wichita	20203	4.28	3.23	6.52	-1.91	-11.85	10.70
Kansas	Wilson	20205	2.98	1.94	4.29	-2.28	-11.14	9.02
Kansas	Woodson	20207	3.12	2.21	4.20	-2.04	-8.94	4.28
Kansas	Wyandotte	20209	5.76	4.80	7.28	-3.54	-8.66	2.74
Kentucky	Adair	21001	4.23	3.06	6.00	3.06	-4.09	12.44
Kentucky	Allen	21003	4.55	3.15	6.23	-2.74	-10.99	5.53
Kentucky	Anderson	21005	3.78	2.81	5.25	4.16	-6.17	13.60
Kentucky	Ballard	21007	3.50	2.57	4.92	-7.19	-14.11	0.59
Kentucky	Barren	21009	3.03	2.15	4.08	0.50	-8.25	9.64
Kentucky	Bath	21011	4.40	3.40	5.84	0.76	-5.86	10.48
Kentucky	Bell	21013	8.14	5.64	10.73	11.25	1.32	19.23
Kentucky	Boone	21015	2.65	2.13	3.32	1.46	-5.27	9.23
Kentucky	Bourbon	21017	5.01	3.49	6.76	-0.65	-7.22	6.95
Kentucky	Boyd	21019	*	*	*	*	*	*
Kentucky	Boyle	21021	4.60	3.38	5.87	1.44	-5.57	12.20
Kentucky	Bracken	21023	3.37	2.61	4.67	2.74	-4.46	11.43
Kentucky	Breathitt	21025	7.89	5.48	11.46	5.40	-2.53	14.39
Kentucky	Breckinridge	21027	3.52	2.35	5.14	0.26	-9.96	7.04
Kentucky	Bullitt	21029	2.52	1.64	3.70	3.01	-5.75	15.03
Kentucky	Butler	21031	3.05	2.22	4.34	-2.21	-10.63	6.37
Kentucky	Caldwell	21033	3.80	2.92	5.15	-6.19	-14.15	1.48

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			2017 Rate per 100,000			2013-2017 AAPC		
State	**County**	**FIPS**	**rate**	**95% CI**		**AAPC**	**95% CI**	
Kentucky	Calloway	21035	3.34	2.61	4.96	-7.81	-13.89	-0.55
Kentucky	Campbell	21037	5.14	4.01	7.03	0.17	-8.11	9.24
Kentucky	Carlisle	21039	2.77	2.08	4.30	-6.63	-12.78	1.89
Kentucky	Carroll	21041	*	*	*	*	*	*
Kentucky	Carter	21043	5.70	4.07	8.21	1.00	-5.62	13.75
Kentucky	Casey	21045	3.96	2.69	6.34	4.42	-2.67	12.18
Kentucky	Christian	21047	6.00	4.83	7.64	-4.06	-10.00	2.10
Kentucky	Clark	21049	5.56	4.42	7.76	2.42	-10.38	11.96
Kentucky	Clay	21051	7.49	5.22	10.41	5.16	-2.31	14.12
Kentucky	Clinton	21053	5.27	2.89	7.28	1.86	-10.88	9.36
Kentucky	Crittenden	21055	*	*	*	*	*	*
Kentucky	Cumberland	21057	4.12	3.33	5.43	-0.92	-8.70	7.43
Kentucky	Daviess	21059	3.17	2.33	4.32	-2.34	-9.27	5.17
Kentucky	Edmonson	21061	2.85	1.82	4.12	0.12	-9.37	7.88
Kentucky	Elliott	21063	*	*	*	*	*	*
Kentucky	Estill	21065	6.56	4.80	10.04	3.05	-6.85	14.46
Kentucky	Fayette	21067	6.84	5.78	8.53	1.78	-3.43	8.08
Kentucky	Fleming	21069	3.65	2.55	5.02	2.20	-8.04	11.80
Kentucky	Floyd	21071	4.71	3.37	6.35	5.66	-3.15	14.14
Kentucky	Franklin	21073	3.95	2.62	4.90	2.12	-7.06	9.90
Kentucky	Fulton	21075	4.10	3.17	5.60	-8.67	-15.92	-2.60
Kentucky	Gallatin	21077	3.32	2.12	4.58	2.40	-5.63	12.49
Kentucky	Garrard	21079	4.99	3.61	6.33	3.51	-3.83	13.31
Kentucky	Grant	21081	3.64	2.86	5.21	0.79	-6.66	7.18
Kentucky	Graves	21083	3.39	2.48	4.71	-9.61	-17.18	-0.46
Kentucky	Grayson	21085	*	*	*	*	*	*
Kentucky	Green	21087	3.23	2.42	4.30	3.00	-5.06	10.39
Kentucky	Greenup	21089	*	*	*	*	*	*
Kentucky	Hancock	21091	*	*	*	*	*	*
Kentucky	Hardin	21093	3.29	2.11	4.20	0.58	-7.35	6.82
Kentucky	Harlan	21095	16.36	11.19	25.22	9.62	-2.87	21.26
Kentucky	Harrison	21097	3.26	2.22	4.49	1.62	-7.02	8.75
Kentucky	Hart	21099	3.08	2.32	4.78	1.52	-6.13	8.94
Kentucky	Henderson	21101	4.20	3.41	5.24	-2.99	-9.73	4.38
Kentucky	Henry	21103	3.37	2.08	4.54	3.29	-4.30	11.79
Kentucky	Hickman	21105	2.96	1.94	3.93	-9.75	-17.17	-1.96
Kentucky	Hopkins	21107	6.27	4.80	7.85	-6.07	-13.80	1.64
Kentucky	Jackson	21109	5.01	3.42	6.43	5.19	-3.76	12.96
Kentucky	Jefferson	21111	4.81	3.97	5.64	4.48	-1.09	10.25
Kentucky	Jessamine	21113	6.70	4.51	9.60	6.16	-1.10	13.80

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State	County	FIPS	2017 Rate per 100,000 rate	95% CI		2013-2017 AAPC AAPC	95% CI	
Kentucky	Johnson	21115	6.24	4.52	9.54	4.39	-3.90	17.40
Kentucky	Kenton	21117	5.93	4.55	7.64	0.90	-5.54	8.27
Kentucky	Knott	21119	5.61	3.27	7.77	6.31	-2.71	18.32
Kentucky	Knox	21121	8.00	5.57	11.76	9.89	1.73	19.35
Kentucky	Larue	21123	3.71	2.73	4.98	0.02	-7.43	8.89
Kentucky	Laurel	21125	4.99	3.83	7.72	6.13	-2.30	19.21
Kentucky	Lawrence	21127	6.70	5.05	8.97	2.97	-6.90	11.15
Kentucky	Lee	21129	*	*	*	*	*	*
Kentucky	Leslie	21131	*	*	*	*	*	*
Kentucky	Letcher	21133	9.97	5.46	13.38	9.47	-3.76	19.89
Kentucky	Lewis	21135	4.62	3.12	6.41	4.17	-4.52	13.86
Kentucky	Lincoln	21137	*	*	*	*	*	*
Kentucky	Livingston	21139	4.05	2.95	6.68	-4.29	-12.17	5.53
Kentucky	Logan	21141	5.24	3.90	7.31	-4.86	-11.73	2.24
Kentucky	Lyon	21143	3.15	2.14	4.72	-9.60	-20.14	0.76
Kentucky	McCracken	21145	5.38	3.62	6.65	-6.53	-16.58	0.62
Kentucky	McCreary	21147	5.42	3.67	7.41	5.60	-3.06	16.05
Kentucky	McLean	21149	4.47	3.27	5.85	-2.40	-9.72	5.18
Kentucky	Madison	21151	4.05	2.88	5.05	6.62	0.95	13.51
Kentucky	Magoffin	21153	5.41	3.57	7.95	4.82	-3.91	14.83
Kentucky	Marion	21155	5.51	4.39	7.24	3.90	-3.40	11.54
Kentucky	Marshall	21157	2.74	2.11	3.78	-5.95	-19.16	6.57
Kentucky	Martin	21159	6.30	4.04	8.70	3.90	-3.55	13.17
Kentucky	Mason	21161	3.10	2.34	4.75	0.90	-5.59	9.92
Kentucky	Meade	21163	2.78	1.77	4.13	-0.50	-8.73	9.33
Kentucky	Menifee	21165	*	*	*	*	*	*
Kentucky	Mercer	21167	5.39	3.70	6.89	4.45	-3.70	12.23
Kentucky	Metcalfe	21169	3.72	2.88	5.00	1.00	-7.13	10.09
Kentucky	Monroe	21171	3.03	2.19	4.76	-0.62	-8.74	6.69
Kentucky	Montgomery	21173	4.46	2.97	6.43	-0.01	-9.31	11.80
Kentucky	Morgan	21175	5.74	4.17	8.65	3.18	-4.14	12.45
Kentucky	Muhlenberg	21177	3.73	2.88	4.80	-1.94	-9.28	6.15
Kentucky	Nelson	21179	3.95	2.47	5.46	5.12	-3.19	13.37
Kentucky	Nicholas	21181	3.89	2.96	5.49	1.44	-6.38	9.26
Kentucky	Ohio	21183	3.98	2.83	5.22	-1.46	-9.37	7.91
Kentucky	Oldham	21185	4.38	3.16	6.41	4.59	-4.94	14.96
Kentucky	Owen	21187	3.14	2.50	4.21	2.10	-5.18	9.16
Kentucky	Owsley	21189	7.23	5.14	9.56	6.52	-1.96	14.61
Kentucky	Pendleton	21191	*	*	*	*	*	*
Kentucky	Perry	21193	10.51	5.53	13.25	8.74	1.50	15.94

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State	**County**	**FIPS**	**rate**	**95% CI**		**AAPC**	**95% CI**	
Kentucky	Pike	21195	5.98	4.19	7.79	6.45	-2.55	13.95
Kentucky	Powell	21197	8.81	5.62	14.42	2.73	-7.42	14.87
Kentucky	Pulaski	21199	4.68	3.21	6.73	7.48	-1.38	15.79
Kentucky	Robertson	21201	*	*	*	*	*	*
Kentucky	Rockcastle	21203	5.31	3.45	8.00	4.29	-5.80	14.85
Kentucky	Rowan	21205	4.57	3.05	6.61	3.41	-3.56	11.23
Kentucky	Russell	21207	5.00	3.62	6.58	3.62	-3.68	12.04
Kentucky	Scott	21209	3.32	2.39	4.32	4.43	-3.65	12.45
Kentucky	Shelby	21211	3.55	2.66	4.60	3.12	-6.08	9.50
Kentucky	Simpson	21213	4.64	3.21	6.75	-3.77	-13.04	5.39
Kentucky	Spencer	21215	4.43	3.18	5.80	4.52	-3.27	12.94
Kentucky	Taylor	21217	5.40	2.73	7.23	2.99	-6.97	11.29
Kentucky	Todd	21219	5.31	3.36	6.84	-4.74	-13.08	4.03
Kentucky	Trigg	21221	3.99	3.13	5.23	-6.19	-14.18	1.83
Kentucky	Trimble	21223	4.03	2.88	5.51	2.03	-7.73	9.48
Kentucky	Union	21225	5.18	3.88	6.87	-3.37	-11.26	3.92
Kentucky	Warren	21227	4.31	3.18	5.59	-3.05	-10.92	5.31
Kentucky	Washington	21229	4.21	2.88	5.81	5.09	-5.83	14.12
Kentucky	Wayne	21231	5.88	3.73	8.82	7.73	-1.12	16.10
Kentucky	Webster	21233	6.77	4.59	9.08	-4.76	-10.77	3.99
Kentucky	Whitley	21235	8.15	4.93	11.65	8.66	0.31	20.68
Kentucky	Wolfe	21237	*	*	*	*	*	*
Kentucky	Woodford	21239	3.22	2.30	4.63	4.37	-3.49	10.80
Louisiana	Acadia	22001	4.65	3.21	6.18	1.24	-6.87	8.79
Louisiana	Allen	22003	4.79	3.44	5.94	-0.93	-9.03	6.11
Louisiana	Ascension	22005	3.81	2.97	5.48	6.61	-1.61	14.92
Louisiana	Assumption	22007	4.01	3.30	4.92	5.32	-4.34	12.27
Louisiana	Avoyelles	22009	4.91	3.79	6.21	-0.29	-6.74	5.76
Louisiana	Beauregard	22011	3.76	2.56	4.81	-0.43	-6.23	5.56
Louisiana	Bienville	22013	5.62	4.33	7.48	-1.05	-7.79	10.32
Louisiana	Bossier	22015	8.81	6.72	11.45	1.87	-5.48	8.46
Louisiana	Caddo	22017	22.82	19.00	26.53	1.24	-3.77	5.56
Louisiana	Calcasieu	22019	3.41	2.64	4.43	-0.38	-6.10	6.37
Louisiana	Caldwell	22021	4.57	3.49	5.97	-3.08	-8.55	4.87
Louisiana	Cameron	22023	4.16	2.80	5.56	-0.31	-9.40	10.59
Louisiana	Catahoula	22025	4.60	3.28	6.15	-2.83	-10.18	3.90
Louisiana	Claiborne	22027	3.60	2.56	5.85	-3.40	-9.64	5.17
Louisiana	Concordia	22029	4.57	3.59	6.12	-1.16	-7.42	4.93
Louisiana	De Soto	22031	7.42	5.43	9.43	-0.06	-5.21	7.07
Louisiana	East Baton Rouge	22033	6.45	5.52	7.93	5.62	-0.70	12.79

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			2017 Rate per 100,000			2013-2017 AAPC		
State	**County**	**FIPS**	**rate**	**95% CI**		**AAPC**	**95% CI**	
Louisiana	East Carroll	22035	4.18	3.24	5.57	-5.67	-13.08	-1.02
Louisiana	East Feliciana	22037	5.43	4.22	7.65	2.30	-6.80	10.47
Louisiana	Evangeline	22039	4.40	2.99	5.38	-0.06	-8.37	7.41
Louisiana	Franklin	22041	3.46	2.23	4.60	-3.32	-12.07	4.34
Louisiana	Grant	22043	8.50	5.12	12.50	-1.28	-13.65	11.63
Louisiana	Iberia	22045	4.07	3.25	4.90	1.65	-6.65	8.49
Louisiana	Iberville	22047	7.82	5.40	9.93	1.99	-8.80	8.63
Louisiana	Jackson	22049	4.64	3.10	7.15	-1.49	-10.81	6.29
Louisiana	Jefferson	22051	8.13	6.48	9.94	7.41	-1.42	14.65
Louisiana	Jefferson Davis	22053	4.03	3.09	6.38	-1.72	-10.31	6.85
Louisiana	Lafayette	22055	4.48	3.57	5.58	-0.26	-8.32	8.12
Louisiana	Lafourche	22057	4.59	3.31	6.12	8.27	-5.28	16.27
Louisiana	La Salle	22059	4.76	3.41	7.78	-3.57	-12.26	5.52
Louisiana	Lincoln	22061	4.86	3.20	6.28	-2.45	-9.86	7.12
Louisiana	Livingston	22063	3.58	2.18	4.77	9.53	-1.02	17.39
Louisiana	Madison	22065	4.06	2.99	5.49	-5.62	-11.58	2.79
Louisiana	Morehouse	22067	4.24	3.20	5.83	-3.87	-10.00	3.41
Louisiana	Natchitoches	22069	6.24	4.73	8.05	-0.19	-6.26	5.29
Louisiana	Orleans	22071	7.13	5.49	9.01	3.08	-3.96	9.54
Louisiana	Ouachita	22073	7.15	5.29	9.47	0.59	-5.74	7.12
Louisiana	Plaquemines	22075	7.58	5.39	10.65	10.63	0.95	21.25
Louisiana	Pointe Coupee	22077	5.17	3.81	6.63	0.80	-7.52	9.22
Louisiana	Rapides	22079	6.06	4.83	7.93	-2.48	-7.92	2.87
Louisiana	Red River	22081	6.63	5.21	8.43	-1.19	-8.76	4.92
Louisiana	Richland	22083	3.04	2.56	4.32	-4.07	-8.77	1.49
Louisiana	Sabine	22085	5.05	3.91	6.62	0.09	-6.91	6.63
Louisiana	St. Bernard	22087	*	*	*	*	*	*
Louisiana	St. Charles	22089	5.15	3.47	6.78	5.27	-3.06	17.52
Louisiana	St. Helena	22091	5.47	4.14	6.91	5.54	-5.47	15.42
Louisiana	St. James	22093	3.58	2.48	5.48	7.29	-6.38	21.71
Louisiana	St. John the Baptist	22095	3.91	3.16	5.94	6.30	-3.71	15.06
Louisiana	St. Landry	22097	4.72	3.34	6.53	2.34	-4.55	9.25
Louisiana	St. Martin	22099	4.60	3.77	5.67	0.39	-5.54	8.82
Louisiana	St. Mary	22101	5.50	4.00	7.44	4.42	-2.92	12.24
Louisiana	St. Tammany	22103	3.14	2.31	4.10	-2.65	-10.50	4.81
Louisiana	Tangipahoa	22105	6.66	5.52	8.16	7.13	0.62	14.74
Louisiana	Tensas	22107	3.98	2.71	5.31	-3.22	-10.30	5.34
Louisiana	Terrebonne	22109	6.03	4.73	7.89	2.43	-6.12	11.95
Louisiana	Union	22111	3.62	2.58	5.24	-3.28	-10.68	3.56
Louisiana	Vermilion	22113	3.72	2.70	4.70	-2.77	-10.60	3.25

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State	County	FIPS	2017 Rate per 100,000 rate	95% CI		2013-2017 AAPC AAPC	95% CI	
Louisiana	Vernon	22115	5.11	4.04	7.07	0.97	-4.30	8.75
Louisiana	Washington	22117	4.95	3.93	6.53	-1.42	-8.14	5.51
Louisiana	Webster	22119	5.57	3.76	7.08	0.23	-6.46	6.94
Louisiana	West Baton Rouge	22121	6.77	5.04	9.23	3.13	-6.79	12.73
Louisiana	West Carroll	22123	3.35	2.33	5.30	-1.70	-10.34	7.93
Louisiana	West Feliciana	22125	7.03	5.60	9.53	-1.35	-7.73	6.28
Louisiana	Winn	22127	7.23	5.60	10.25	-2.75	-10.85	6.41
Maine	Androscoggin	23001	2.49	1.82	3.21	-8.99	-17.94	-1.18
Maine	Aroostook	23003	1.59	1.07	2.52	-4.45	-14.84	6.41
Maine	Cumberland	23005	2.03	1.60	2.68	-9.88	-16.70	-0.21
Maine	Franklin	23007	1.79	1.20	2.85	-7.65	-19.88	5.14
Maine	Hancock	23009	2.12	1.27	3.23	-6.43	-19.98	3.21
Maine	Kennebec	23011	2.52	1.81	3.42	-8.50	-16.30	2.62
Maine	Knox	23013	*	*	*	*	*	*
Maine	Lincoln	23015	1.49	1.02	2.21	-7.39	-18.19	8.59
Maine	Oxford	23017	*	*	*	*	*	*
Maine	Penobscot	23019	2.49	1.91	3.11	-5.90	-13.65	3.02
Maine	Piscataquis	23021	*	*	*	*	*	*
Maine	Sagadahoc	23023	1.60	1.17	2.01	-6.04	-17.02	1.30
Maine	Somerset	23025	2.33	1.80	3.41	-6.20	-18.16	3.83
Maine	Waldo	23027	*	*	*	*	*	*
Maine	Washington	23029	*	*	*	*	*	*
Maine	York	23031	1.81	1.34	2.50	-12.89	-20.69	-5.69
Maryland	Allegany	24001	3.28	2.50	4.31	-0.89	-8.00	7.33
Maryland	Anne Arundel	24003	3.24	2.70	3.93	-2.29	-8.60	4.38
Maryland	Baltimore	24005	4.47	3.67	5.25	-0.62	-6.70	4.47
Maryland	Calvert	24009	2.55	1.54	3.74	-2.42	-10.94	11.84
Maryland	Caroline	24011	3.78	2.83	5.43	-6.31	-14.34	2.88
Maryland	Carroll	24013	2.73	1.98	4.08	-0.19	-8.31	9.52
Maryland	Cecil	24015	3.27	2.58	4.36	-6.12	-12.91	1.15
Maryland	Charles	24017	3.65	2.88	4.91	-0.09	-8.39	9.55
Maryland	Dorchester	24019	3.86	2.80	5.32	-6.04	-13.78	1.61
Maryland	Frederick	24021	2.05	1.73	2.64	-1.58	-7.75	4.34
Maryland	Garrett	24023	3.56	2.66	5.26	2.17	-5.45	11.44
Maryland	Harford	24025	2.66	2.03	3.35	-2.47	-9.25	4.42
Maryland	Howard	24027	2.38	1.90	3.14	0.51	-5.84	9.10
Maryland	Kent	24029	4.27	3.23	5.59	-3.96	-11.67	6.84
Maryland	Montgomery	24031	1.82	1.49	2.13	-3.17	-7.49	0.82
Maryland	Prince George's	24033	4.73	4.03	5.68	-4.49	-9.51	0.52
Maryland	Queen Anne's	24035	2.97	1.90	4.73	-3.28	-13.20	6.10

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State	County	FIPS	2017 Rate per 100,000 rate	95% CI		2013-2017 AAPC AAPC	95% CI	
Maryland	St. Mary's	24037	3.95	2.13	5.50	1.35	-19.14	10.91
Maryland	Somerset	24039	2.61	1.93	3.78	-10.07	-18.41	0.15
Maryland	Talbot	24041	2.27	1.62	3.35	-8.48	-18.91	4.15
Maryland	Washington	24043	4.81	3.51	7.10	-2.57	-9.01	5.65
Maryland	Wicomico	24045	2.46	1.76	3.56	-9.11	-17.38	0.45
Maryland	Worcester	24047	2.04	1.54	2.79	-10.92	-19.09	-0.64
Maryland	Baltimore City	24510	15.66	13.43	17.81	1.79	-2.81	6.26
Massachusetts	Barnstable	25001	2.22	1.64	2.79	-8.68	-16.40	0.00
Massachusetts	Berkshire	25003	2.70	2.13	4.02	-5.11	-11.67	1.52
Massachusetts	Bristol	25005	3.38	2.67	4.86	-4.72	-11.92	6.96
Massachusetts	Dukes	25007	*	*	*	*	*	*
Massachusetts	Essex	25009	2.45	1.92	3.12	-12.36	-17.08	-5.14
Massachusetts	Franklin	25011	2.81	2.10	3.50	-3.22	-11.83	3.76
Massachusetts	Hampden	25013	4.25	3.54	5.56	-2.50	-7.26	4.67
Massachusetts	Hampshire	25015	2.21	1.57	2.95	-2.69	-12.98	5.44
Massachusetts	Middlesex	25017	2.21	1.86	2.68	-5.79	-10.04	-0.50
Massachusetts	Nantucket	25019	3.25	2.18	5.08	-3.61	-14.19	13.15
Massachusetts	Norfolk	25021	2.01	1.66	2.36	-5.67	-10.45	-0.79
Massachusetts	Plymouth	25023	1.90	1.47	2.58	-12.77	-18.93	-1.04
Massachusetts	Suffolk	25025	5.52	4.53	6.73	-3.07	-8.94	2.97
Massachusetts	Worcester	25027	3.49	2.91	4.09	-2.10	-7.48	2.50
Michigan	Alcona	26001	3.96	2.89	6.02	0.55	-11.36	10.97
Michigan	Alger	26003	*	*	*	*	*	*
Michigan	Allegan	26005	1.72	1.11	2.29	-9.01	-15.79	2.10
Michigan	Alpena	26007	*	*	*	*	*	*
Michigan	Antrim	26009	2.35	1.63	3.42	-7.84	-16.00	0.81
Michigan	Arenac	26011	2.74	1.87	4.15	-5.45	-16.73	4.08
Michigan	Baraga	26013	2.86	1.93	3.88	-4.41	-16.74	9.47
Michigan	Barry	26015	2.24	1.59	3.08	-8.12	-14.52	1.02
Michigan	Bay	26017	1.62	1.20	2.31	-9.05	-18.79	-0.83
Michigan	Benzie	26019	*	*	*	*	*	*
Michigan	Berrien	26021	2.72	2.03	3.65	-8.31	-14.49	1.70
Michigan	Branch	26023	3.23	2.33	4.53	-6.19	-13.64	1.93
Michigan	Calhoun	26025	3.78	2.94	4.52	-8.79	-14.11	-2.70
Michigan	Cass	26027	1.91	1.41	3.18	-8.21	-14.89	1.14
Michigan	Charlevoix	26029	2.55	1.75	3.88	-4.01	-15.47	7.66
Michigan	Cheboygan	26031	*	*	*	*	*	*
Michigan	Chippewa	26033	4.26	3.08	5.96	3.64	-7.75	15.90
Michigan	Clare	26035	3.12	2.31	4.45	-9.14	-15.62	-0.64
Michigan	Clinton	26037	2.11	1.59	2.69	-6.82	-13.71	1.43

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			2017 Rate per 100,000			2013-2017 AAPC		
State	**County**	**FIPS**	**rate**	**95% CI**		**AAPC**	**95% CI**	
Michigan	Crawford	26039	*	*	*	*	*	*
Michigan	Delta	26041	2.12	1.11	3.00	-4.02	-13.58	9.73
Michigan	Dickinson	26043	2.35	1.63	3.19	-6.94	-17.50	5.54
Michigan	Eaton	26045	2.65	1.95	3.58	-7.46	-15.33	2.93
Michigan	Emmet	26047	*	*	*	*	*	*
Michigan	Genesee	26049	3.24	2.57	3.95	-9.79	-14.69	-4.36
Michigan	Gladwin	26051	2.59	1.81	3.53	-9.31	-17.39	-2.09
Michigan	Gogebic	26053	3.38	2.39	5.03	-5.20	-18.78	4.52
Michigan	Grand Traverse	26055	2.11	1.48	2.84	-6.89	-14.82	1.74
Michigan	Gratiot	26057	2.44	1.78	3.07	-6.98	-13.62	-1.21
Michigan	Hillsdale	26059	2.88	2.24	3.83	-3.39	-10.45	5.97
Michigan	Houghton	26061	*	*	*	*	*	*
Michigan	Huron	26063	*	*	*	*	*	*
Michigan	Ingham	26065	4.30	3.32	5.32	-9.29	-14.94	-3.53
Michigan	Ionia	26067	3.05	1.92	4.65	-8.80	-14.42	0.80
Michigan	Iosco	26069	*	*	*	*	*	*
Michigan	Iron	26071	2.51	1.98	3.38	-4.17	-15.21	5.51
Michigan	Isabella	26073	2.46	1.86	3.27	-9.54	-17.14	-3.55
Michigan	Jackson	26075	5.65	4.24	7.05	-6.26	-13.52	-0.24
Michigan	Kalamazoo	26077	2.54	2.08	3.18	-10.29	-15.20	-4.27
Michigan	Kalkaska	26079	*	*	*	*	*	*
Michigan	Kent	26081	3.24	2.56	3.88	-9.24	-15.63	-3.66
Michigan	Keweenaw	26083	*	*	*	*	*	*
Michigan	Lake	26085	3.51	2.82	4.57	-7.61	-14.88	-0.79
Michigan	Lapeer	26087	*	*	*	*	*	*
Michigan	Leelanau	26089	1.62	1.10	2.55	-7.70	-17.39	7.52
Michigan	Lenawee	26091	3.55	2.68	5.53	-1.23	-9.23	7.46
Michigan	Livingston	26093	2.08	1.48	2.62	-5.50	-12.77	1.75
Michigan	Luce	26095	4.32	3.14	6.47	-1.97	-14.21	11.76
Michigan	Mackinac	26097	*	*	*	*	*	*
Michigan	Macomb	26099	2.23	1.82	2.67	-8.66	-14.29	-3.66
Michigan	Manistee	26101	2.42	1.70	3.30	-8.44	-16.75	0.48
Michigan	Marquette	26103	2.41	1.72	3.60	-5.02	-15.62	6.44
Michigan	Mason	26105	*	*	*	*	*	*
Michigan	Mecosta	26107	3.00	2.26	4.07	-8.44	-17.60	-0.81
Michigan	Menominee	26109	*	*	*	*	*	*
Michigan	Midland	26111	1.90	1.45	2.54	-7.45	-14.40	0.60
Michigan	Missaukee	26113	*	*	*	*	*	*
Michigan	Monroe	26115	2.55	2.02	3.36	-7.47	-14.13	1.19
Michigan	Montcalm	26117	2.36	1.80	3.01	-6.67	-13.17	-0.42

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State	County	FIPS	2017 Rate per 100,000 rate	95% CI		2013-2017 AAPC AAPC	95% CI	
Michigan	Montmorency	26119	4.53	3.38	5.82	-1.63	-10.83	5.45
Michigan	Muskegon	26121	4.95	3.83	6.20	-5.11	-11.96	2.01
Michigan	Newaygo	26123	2.81	2.06	3.89	-10.00	-16.89	-2.38
Michigan	Oakland	26125	2.04	1.61	2.44	-10.00	-14.96	-5.83
Michigan	Oceana	26127	*	*	*	*	*	*
Michigan	Ogemaw	26129	3.06	2.29	4.62	-3.51	-11.76	5.13
Michigan	Ontonagon	26131	*	*	*	*	*	*
Michigan	Osceola	26133	2.85	2.01	3.77	-7.67	-13.70	1.30
Michigan	Oscoda	26135	3.73	2.83	5.20	-1.25	-10.61	7.92
Michigan	Otsego	26137	2.96	1.93	4.22	-5.17	-12.83	5.81
Michigan	Ottawa	26139	1.81	1.24	2.66	-3.82	-13.37	4.88
Michigan	Presque Isle	26141	3.61	2.59	5.10	0.29	-8.82	11.41
Michigan	Roscommon	26143	3.30	2.54	5.05	-6.37	-15.45	3.36
Michigan	Saginaw	26145	3.63	2.99	4.48	-7.70	-14.30	-2.07
Michigan	St. Clair	26147	2.50	1.64	3.72	-6.86	-14.93	2.61
Michigan	St. Joseph	26149	2.20	1.70	3.04	-8.58	-15.55	-0.83
Michigan	Sanilac	26151	*	*	*	*	*	*
Michigan	Schoolcraft	26153	*	*	*	*	*	*
Michigan	Shiawassee	26155	2.06	1.48	2.94	-3.83	-11.21	5.06
Michigan	Tuscola	26157	1.87	1.41	2.64	-8.38	-16.08	2.16
Michigan	Van Buren	26159	2.01	1.39	2.69	-9.25	-15.12	-2.32
Michigan	Washtenaw	26161	3.34	2.45	4.05	-6.79	-12.51	-2.08
Michigan	Wayne	26163	4.19	3.69	4.93	-9.95	-13.85	-5.70
Michigan	Wexford	26165	2.98	2.17	3.91	-5.35	-13.61	2.20
Minnesota	Aitkin	27001	2.94	2.16	3.83	-1.20	-10.71	5.36
Minnesota	Anoka	27003	2.83	2.22	3.51	0.68	-5.69	6.36
Minnesota	Becker	27005	2.52	1.97	3.27	-4.49	-11.54	4.03
Minnesota	Beltrami	27007	3.31	2.65	4.38	-3.75	-11.78	3.84
Minnesota	Benton	27009	2.26	1.58	3.81	-1.71	-10.00	7.50
Minnesota	Big Stone	27011	1.74	1.14	2.70	-6.55	-14.79	0.93
Minnesota	Blue Earth	27013	1.97	1.41	2.91	-5.88	-13.02	1.62
Minnesota	Brown	27015	1.58	1.03	2.30	-7.23	-16.01	2.72
Minnesota	Carlton	27017	3.19	2.21	5.33	-4.64	-13.91	3.48
Minnesota	Carver	27019	1.91	1.36	2.73	-0.19	-8.62	9.52
Minnesota	Cass	27021	3.63	2.73	4.56	-6.05	-11.90	1.24
Minnesota	Chippewa	27023	1.92	1.39	2.94	-5.64	-14.32	5.47
Minnesota	Chisago	27025	2.75	1.60	3.76	-1.05	-10.41	6.91
Minnesota	Clay	27027	2.33	1.83	2.99	-5.27	-12.42	2.82
Minnesota	Clearwater	27029	2.55	1.96	3.40	-5.22	-12.36	2.79
Minnesota	Cook	27031	*	*	*	*	*	*

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State	County	FIPS	2017 Rate per 100,000 rate	95% CI		2013-2017 AAPC AAPC	95% CI	
Minnesota	Cottonwood	27033	*	*	*	*	*	*
Minnesota	Crow Wing	27035	2.44	1.84	3.36	-4.43	-15.22	3.01
Minnesota	Dakota	27037	2.00	1.54	2.45	-2.85	-8.73	3.34
Minnesota	Dodge	27039	2.67	1.98	3.88	-8.22	-15.17	1.08
Minnesota	Douglas	27041	*	*	*	*	*	*
Minnesota	Faribault	27043	2.22	1.64	3.29	-4.43	-16.22	4.92
Minnesota	Fillmore	27045	2.30	1.59	3.11	-6.18	-15.53	4.15
Minnesota	Freeborn	27047	2.49	1.92	3.58	-6.51	-13.55	5.55
Minnesota	Goodhue	27049	2.20	1.49	3.39	-8.03	-14.60	-1.71
Minnesota	Grant	27051	2.69	1.99	3.57	-6.37	-13.79	1.95
Minnesota	Hennepin	27053	5.00	4.35	5.78	-1.13	-5.24	3.56
Minnesota	Houston	27055	2.07	1.49	2.82	-5.71	-12.32	3.41
Minnesota	Hubbard	27057	3.03	1.99	4.18	-6.24	-15.53	2.05
Minnesota	Isanti	27059	3.53	2.41	4.86	-0.44	-9.39	8.11
Minnesota	Itasca	27061	3.60	2.46	4.61	-3.04	-11.23	7.00
Minnesota	Jackson	27063	1.96	1.37	2.82	-6.31	-15.10	1.40
Minnesota	Kanabec	27065	3.15	2.16	4.66	-0.06	-9.25	7.87
Minnesota	Kandiyohi	27067	1.82	1.20	2.51	-4.40	-11.89	4.27
Minnesota	Kittson	27069	*	*	*	*	*	*
Minnesota	Koochiching	27071	*	*	*	*	*	*
Minnesota	Lac qui Parle	27073	2.39	1.39	3.54	-7.36	-15.52	2.21
Minnesota	Lake	27075	*	*	*	*	*	*
Minnesota	Lake of the Woods	27077	2.77	1.98	4.01	0.39	-10.63	9.95
Minnesota	Le Sueur	27079	2.24	1.42	2.84	-3.23	-10.10	4.97
Minnesota	Lincoln	27081	2.18	1.57	3.08	-4.60	-11.60	5.59
Minnesota	Lyon	27083	1.62	1.12	2.16	-1.78	-9.81	6.87
Minnesota	McLeod	27085	2.06	1.16	3.05	-3.38	-12.68	6.49
Minnesota	Mahnomen	27087	3.49	2.75	4.47	-5.02	-12.37	6.19
Minnesota	Marshall	27089	2.88	2.07	3.85	-4.97	-11.88	2.95
Minnesota	Martin	27091	1.97	1.43	2.95	-7.46	-16.14	2.12
Minnesota	Meeker	27093	2.03	1.46	2.95	-3.63	-11.77	5.66
Minnesota	Mille Lacs	27095	2.68	1.83	4.42	-4.14	-10.41	5.20
Minnesota	Morrison	27097	2.02	1.31	2.92	-5.12	-12.41	2.63
Minnesota	Mower	27099	2.80	1.75	3.97	-7.29	-17.93	-0.12
Minnesota	Murray	27101	2.02	1.58	2.80	-3.71	-11.13	3.78
Minnesota	Nicollet	27103	1.78	1.38	2.39	-3.46	-10.56	4.79
Minnesota	Nobles	27105	2.06	1.55	2.92	-3.33	-9.60	4.23
Minnesota	Norman	27107	2.40	1.64	3.39	-5.01	-13.78	5.22
Minnesota	Olmsted	27109	4.66	3.48	6.83	-11.30	-18.42	-2.27
Minnesota	Otter Tail	27111	2.15	1.65	3.09	-7.21	-14.51	0.41

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State	County	FIPS	2017 Rate per 100,000 rate	95% CI		2013-2017 AAPC AAPC	95% CI	
Minnesota	Pennington	27113	2.54	1.89	3.71	-4.28	-12.09	8.22
Minnesota	Pine	27115	3.21	2.30	4.06	-2.13	-9.05	7.05
Minnesota	Pipestone	27117	2.39	1.80	3.18	-4.35	-11.40	4.09
Minnesota	Polk	27119	2.58	2.01	3.28	-6.56	-12.66	0.64
Minnesota	Pope	27121	2.35	1.58	3.44	-4.71	-14.14	4.07
Minnesota	Ramsey	27123	4.20	3.42	4.98	1.49	-5.72	9.10
Minnesota	Red Lake	27125	*	*	*	*	*	*
Minnesota	Redwood	27127	2.04	1.34	2.78	-3.22	-11.69	6.47
Minnesota	Renville	27129	2.28	1.49	2.87	-5.15	-12.84	1.60
Minnesota	Rice	27131	2.18	1.46	3.15	-6.94	-15.29	1.17
Minnesota	Rock	27133	*	*	*	*	*	*
Minnesota	Roseau	27135	2.98	2.04	4.04	0.65	-9.07	10.60
Minnesota	St. Louis	27137	4.01	3.08	5.59	-1.82	-9.84	7.47
Minnesota	Scott	27139	1.90	1.48	2.48	-2.28	-8.94	4.69
Minnesota	Sherburne	27141	2.16	1.55	3.09	-1.23	-9.53	6.07
Minnesota	Sibley	27143	1.85	1.37	2.49	-3.92	-11.18	5.11
Minnesota	Stearns	27145	2.27	1.71	2.98	-5.08	-11.77	1.06
Minnesota	Steele	27147	2.10	1.64	2.99	-6.64	-14.99	3.67
Minnesota	Stevens	27149	1.90	1.52	2.38	-6.46	-14.16	2.16
Minnesota	Swift	27151	2.04	1.24	3.04	-5.86	-14.72	3.97
Minnesota	Todd	27153	1.76	1.28	2.67	-5.09	-14.18	3.49
Minnesota	Traverse	27155	2.16	1.69	3.28	-4.57	-10.90	2.08
Minnesota	Wabasha	27157	2.26	1.47	2.89	-6.07	-13.82	0.95
Minnesota	Wadena	27159	3.30	2.40	4.58	-8.04	-15.55	-0.24
Minnesota	Waseca	27161	1.92	1.39	2.47	-6.01	-15.05	2.85
Minnesota	Washington	27163	1.88	1.51	2.32	-0.75	-6.16	5.09
Minnesota	Watonwan	27165	*	*	*	*	*	*
Minnesota	Wilkin	27167	2.40	1.69	3.52	-5.40	-12.94	1.10
Minnesota	Winona	27169	2.14	1.58	3.27	-4.49	-11.95	1.07
Minnesota	Wright	27171	1.95	1.51	2.60	-2.66	-8.73	5.21
Minnesota	Yellow Medicine	27173	2.25	1.58	3.00	-3.64	-11.01	2.68
Mississippi	Adams	28001	4.48	3.46	5.90	0.07	-5.58	7.75
Mississippi	Alcorn	28003	4.20	3.08	5.56	-3.43	-9.48	1.86
Mississippi	Amite	28005	4.40	3.50	5.64	3.05	-3.68	10.21
Mississippi	Attala	28007	3.88	2.90	5.90	-2.77	-8.10	3.71
Mississippi	Benton	28009	3.86	2.85	6.02	-4.53	-11.02	1.90
Mississippi	Bolivar	28011	3.92	3.16	5.02	-2.90	-9.11	2.89
Mississippi	Calhoun	28013	4.61	3.66	6.54	-1.77	-7.76	5.36
Mississippi	Carroll	28015	4.76	3.90	6.88	-2.31	-9.79	6.13
Mississippi	Chickasaw	28017	3.97	3.01	5.18	-0.24	-8.83	7.27

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State	County	FIPS	2017 Rate per 100,000 rate	95% CI		2013-2017 AAPC AAPC	95% CI	
Mississippi	Choctaw	28019	4.21	3.22	5.40	0.74	-6.33	8.43
Mississippi	Claiborne	28021	3.74	2.61	4.81	-3.87	-10.49	5.82
Mississippi	Clarke	28023	3.17	2.41	4.01	0.97	-7.00	7.76
Mississippi	Clay	28025	*	*	*	*	*	*
Mississippi	Coahoma	28027	4.58	3.16	6.01	-3.03	-11.31	2.73
Mississippi	Copiah	28029	4.27	3.22	5.61	-1.16	-7.32	5.33
Mississippi	Covington	28031	3.95	2.87	5.43	2.01	-5.09	11.09
Mississippi	DeSoto	28033	3.00	2.48	3.82	-4.49	-10.97	1.22
Mississippi	Forrest	28035	4.54	3.54	5.60	0.14	-6.55	5.58
Mississippi	Franklin	28037	*	*	*	*	*	*
Mississippi	George	28039	5.16	3.88	6.64	1.39	-8.65	13.23
Mississippi	Greene	28041	5.12	3.89	6.54	0.21	-11.47	8.76
Mississippi	Grenada	28043	5.49	4.14	7.08	-2.02	-7.35	4.85
Mississippi	Hancock	28045	5.58	3.51	7.27	0.03	-11.30	9.28
Mississippi	Harrison	28047	6.62	5.21	7.95	-0.09	-7.34	6.90
Mississippi	Hinds	28049	5.90	4.86	7.18	-3.96	-9.85	2.81
Mississippi	Holmes	28051	5.04	3.83	6.98	-4.00	-11.63	4.09
Mississippi	Humphreys	28053	5.03	3.64	7.16	-2.50	-10.44	4.19
Mississippi	Issaquena	28055	4.78	3.14	6.47	-4.44	-12.70	2.50
Mississippi	Itawamba	28057	*	*	*	*	*	*
Mississippi	Jackson	28059	8.87	6.92	11.54	0.81	-7.78	10.10
Mississippi	Jasper	28061	3.33	2.69	5.27	-1.57	-6.92	5.79
Mississippi	Jefferson	28063	3.98	3.12	5.41	-1.72	-8.84	6.95
Mississippi	Jefferson Davis	28065	5.08	3.89	6.60	-0.51	-8.03	6.03
Mississippi	Jones	28067	3.97	3.09	5.08	2.86	-4.79	10.35
Mississippi	Kemper	28069	4.09	2.96	5.65	-4.51	-10.23	1.22
Mississippi	Lafayette	28071	3.74	3.11	4.50	-3.50	-10.30	4.47
Mississippi	Lamar	28073	3.65	2.69	5.35	2.27	-4.19	10.24
Mississippi	Lauderdale	28075	2.84	2.00	3.71	-1.18	-5.27	3.48
Mississippi	Lawrence	28077	4.19	3.28	5.54	-0.77	-7.97	7.73
Mississippi	Leake	28079	4.50	3.33	5.68	-3.37	-8.98	4.46
Mississippi	Lee	28081	4.22	3.28	5.84	-1.78	-9.50	7.06
Mississippi	Leflore	28083	4.39	3.37	5.70	-1.55	-7.79	5.48
Mississippi	Lincoln	28085	3.69	2.80	4.87	-0.44	-7.47	6.81
Mississippi	Lowndes	28087	3.57	2.90	4.62	-2.41	-7.79	3.42
Mississippi	Madison	28089	4.80	3.78	5.91	-5.15	-12.67	1.86
Mississippi	Marion	28091	5.39	4.06	6.65	-2.56	-8.35	3.82
Mississippi	Marshall	28093	3.07	1.93	4.27	-4.12	-10.15	2.10
Mississippi	Monroe	28095	4.27	2.90	5.62	-1.34	-8.03	5.34
Mississippi	Montgomery	28097	*	*	*	*	*	*

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			2017 Rate per 100,000			2013-2017 AAPC		
State	**County**	**FIPS**	**rate**	**95% CI**		**AAPC**	**95% CI**	
Mississippi	Neshoba	28099	3.81	3.10	4.75	-2.22	-9.30	2.77
Mississippi	Newton	28101	3.11	2.33	4.27	-1.30	-7.86	4.75
Mississippi	Noxubee	28103	4.26	3.24	5.34	-2.38	-8.63	3.56
Mississippi	Oktibbeha	28105	4.28	3.50	5.45	-2.36	-7.73	4.63
Mississippi	Panola	28107	4.45	3.27	5.84	-2.68	-9.27	5.75
Mississippi	Pearl River	28109	5.37	3.92	7.60	1.31	-5.31	7.48
Mississippi	Perry	28111	5.20	3.47	6.71	-0.76	-7.99	6.90
Mississippi	Pike	28113	6.03	4.40	7.43	0.58	-7.14	9.42
Mississippi	Pontotoc	28115	4.93	3.70	6.39	-0.34	-8.07	10.15
Mississippi	Prentiss	28117	3.58	2.73	5.00	-2.26	-10.52	5.91
Mississippi	Quitman	28119	4.25	2.91	6.28	-6.53	-13.95	2.23
Mississippi	Rankin	28121	4.34	3.44	5.53	-4.99	-11.80	3.46
Mississippi	Scott	28123	3.93	2.99	4.71	-2.71	-8.05	2.10
Mississippi	Sharkey	28125	4.40	3.36	7.03	-3.94	-11.90	4.83
Mississippi	Simpson	28127	4.50	3.07	5.46	-0.57	-10.49	5.63
Mississippi	Smith	28129	3.07	2.35	4.54	0.13	-6.22	6.77
Mississippi	Stone	28131	5.62	4.43	7.11	-0.80	-7.79	7.70
Mississippi	Sunflower	28133	4.97	3.44	6.31	-3.76	-11.94	3.89
Mississippi	Tallahatchie	28135	4.80	3.94	6.54	-3.51	-8.47	1.51
Mississippi	Tate	28137	4.02	3.02	5.23	-3.69	-9.38	5.17
Mississippi	Tippah	28139	*	*	*	*	*	*
Mississippi	Tishomingo	28141	6.22	4.67	8.92	-4.43	-10.26	2.07
Mississippi	Tunica	28143	4.18	3.39	5.94	-4.82	-11.41	2.66
Mississippi	Union	28145	3.21	2.37	5.02	-2.66	-9.19	5.99
Mississippi	Walthall	28147	4.73	3.92	5.76	-2.06	-8.87	6.35
Mississippi	Warren	28149	3.56	2.83	4.81	-4.34	-8.54	4.59
Mississippi	Washington	28151	3.62	2.63	4.87	-2.09	-8.63	4.22
Mississippi	Wayne	28153	4.29	3.18	5.17	-0.98	-7.96	6.10
Mississippi	Webster	28155	5.94	4.25	8.73	-0.03	-6.66	8.00
Mississippi	Wilkinson	28157	4.33	3.35	5.82	0.48	-7.15	9.85
Mississippi	Winston	28159	3.80	3.08	4.63	-3.70	-8.38	2.60
Mississippi	Yalobusha	28161	6.72	5.39	8.51	-4.20	-10.72	2.86
Mississippi	Yazoo	28163	5.14	4.00	6.43	-2.69	-10.22	2.31
Missouri	Adair	29001	2.73	2.08	4.39	-3.35	-12.66	4.63
Missouri	Andrew	29003	3.10	2.25	4.86	-2.61	-10.08	9.08
Missouri	Atchison	29005	*	*	*	*	*	*
Missouri	Audrain	29007	3.11	2.14	4.18	-2.43	-10.03	5.39
Missouri	Barry	29009	3.44	2.22	4.46	-6.50	-13.55	0.10
Missouri	Barton	29011	2.25	1.71	2.86	-3.12	-11.18	4.64
Missouri	Bates	29013	3.29	2.36	4.77	-3.39	-12.22	5.25

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			2017 Rate per 100,000			2013-2017 AAPC		
State	**County**	**FIPS**	**rate**	**95% CI**		**AAPC**	**95% CI**	
Missouri	Benton	29015	4.17	2.47	5.97	-0.97	-10.95	7.76
Missouri	Bollinger	29017	2.85	1.87	4.34	-5.43	-14.49	3.31
Missouri	Boone	29019	3.48	2.87	4.23	-2.57	-9.18	6.60
Missouri	Buchanan	29021	4.96	3.61	7.32	-0.93	-8.16	7.07
Missouri	Butler	29023	4.80	3.91	6.51	-3.89	-9.96	3.55
Missouri	Caldwell	29025	2.40	1.72	3.48	-5.56	-12.62	0.98
Missouri	Callaway	29027	3.98	3.16	5.47	-2.19	-9.28	5.93
Missouri	Camden	29029	*	*	*	*	*	*
Missouri	Cape Girardeau	29031	2.62	2.02	3.40	-3.25	-9.57	3.57
Missouri	Carroll	29033	*	*	*	*	*	*
Missouri	Carter	29035	4.08	3.10	5.52	-1.58	-9.45	5.55
Missouri	Cass	29037	2.99	2.14	4.00	-4.70	-12.98	3.11
Missouri	Cedar	29039	2.41	1.73	3.95	-2.94	-13.57	6.78
Missouri	Chariton	29041	3.10	2.38	4.62	-1.75	-10.39	6.50
Missouri	Christian	29043	2.98	2.27	3.93	-1.95	-8.85	7.12
Missouri	Clark	29045	3.19	2.41	4.55	-5.91	-13.48	2.54
Missouri	Clay	29047	2.63	2.08	3.42	-6.41	-12.72	4.85
Missouri	Clinton	29049	3.13	2.32	4.10	-5.66	-14.76	1.38
Missouri	Cole	29051	4.28	3.39	5.29	-2.17	-9.39	5.40
Missouri	Cooper	29053	*	*	*	*	*	*
Missouri	Crawford	29055	3.24	2.46	4.40	-3.19	-9.75	7.25
Missouri	Dade	29057	3.92	2.84	5.38	-5.20	-14.81	2.16
Missouri	Dallas	29059	4.92	4.06	6.14	-4.22	-10.53	3.89
Missouri	Daviess	29061	3.40	2.14	4.81	-6.54	-14.55	1.71
Missouri	DeKalb	29063	4.29	3.05	5.84	-5.73	-12.68	3.16
Missouri	Dent	29065	3.40	2.42	4.99	-2.65	-10.71	4.72
Missouri	Douglas	29067	*	*	*	*	*	*
Missouri	Dunklin	29069	4.90	3.35	6.67	-3.87	-10.68	3.75
Missouri	Franklin	29071	2.63	2.03	3.57	-5.58	-11.61	1.76
Missouri	Gasconade	29073	3.85	2.81	5.30	-1.97	-9.41	5.34
Missouri	Gentry	29075	*	*	*	*	*	*
Missouri	Greene	29077	5.77	4.56	7.19	-4.15	-10.38	2.68
Missouri	Grundy	29079	3.22	2.14	4.49	-7.23	-13.87	1.42
Missouri	Harrison	29081	3.20	2.36	4.75	-3.71	-12.16	4.22
Missouri	Henry	29083	2.77	1.82	3.81	-3.10	-10.49	6.65
Missouri	Hickory	29085	5.68	3.92	7.87	-4.55	-12.58	4.52
Missouri	Holt	29087	3.42	2.41	5.07	-1.45	-10.13	8.22
Missouri	Howard	29089	3.50	2.62	4.70	-3.26	-10.98	6.88
Missouri	Howell	29091	5.84	4.55	8.04	-2.03	-10.56	4.93
Missouri	Iron	29093	4.06	2.89	5.65	-1.91	-9.97	7.77

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			2017 Rate per 100,000			2013-2017 AAPC		
State	**County**	**FIPS**	**rate**	**95% CI**		**AAPC**	**95% CI**	
Missouri	Jackson	29095	4.92	4.19	5.64	-6.89	-10.83	-2.21
Missouri	Jasper	29097	3.45	2.50	4.84	-4.50	-12.44	3.63
Missouri	Jefferson	29099	3.40	2.73	4.34	-2.23	-9.29	5.58
Missouri	Johnson	29101	3.28	2.52	4.22	-4.76	-12.74	3.94
Missouri	Knox	29103	*	*	*	*	*	*
Missouri	Laclede	29105	*	*	*	*	*	*
Missouri	Lafayette	29107	3.02	2.43	4.14	-7.04	-13.87	-0.14
Missouri	Lawrence	29109	3.87	2.97	5.24	-5.73	-12.20	0.49
Missouri	Lewis	29111	3.33	2.04	5.06	-4.46	-11.93	7.16
Missouri	Lincoln	29113	2.15	1.54	3.04	1.32	-6.75	10.90
Missouri	Linn	29115	2.43	1.69	3.22	-5.89	-13.25	2.62
Missouri	Livingston	29117	2.53	1.85	3.92	-5.70	-14.66	3.08
Missouri	McDonald	29119	4.75	3.53	6.30	-9.57	-16.54	-1.71
Missouri	Macon	29121	3.55	2.61	4.81	-4.38	-11.71	3.19
Missouri	Madison	29123	5.06	3.35	6.74	-2.25	-11.50	7.02
Missouri	Maries	29125	*	*	*	*	*	*
Missouri	Marion	29127	3.36	2.15	4.86	-3.40	-12.34	7.42
Missouri	Mercer	29129	3.03	1.96	4.30	-5.76	-12.72	3.25
Missouri	Miller	29131	3.98	3.15	5.07	-2.00	-11.77	7.56
Missouri	Mississippi	29133	3.34	2.42	4.15	-7.53	-13.74	-0.80
Missouri	Moniteau	29135	3.17	2.07	4.36	-1.66	-9.42	6.64
Missouri	Monroe	29137	3.25	2.56	4.35	-2.90	-8.91	5.88
Missouri	Montgomery	29139	2.83	2.20	3.96	-0.90	-8.28	6.21
Missouri	Morgan	29141	3.93	2.91	5.34	-3.92	-12.61	5.65
Missouri	New Madrid	29143	4.00	2.79	5.89	-5.32	-12.70	1.08
Missouri	Newton	29145	3.07	2.10	4.02	-8.20	-14.11	-1.72
Missouri	Nodaway	29147	2.56	1.61	3.60	-3.55	-9.79	3.65
Missouri	Oregon	29149	4.59	3.38	6.14	-0.17	-7.88	6.62
Missouri	Osage	29151	2.51	1.96	3.19	-0.60	-8.15	9.66
Missouri	Ozark	29153	4.29	3.32	5.81	-2.13	-10.00	7.58
Missouri	Pemiscot	29155	4.35	3.59	5.72	-4.37	-11.23	2.83
Missouri	Perry	29157	3.60	2.68	4.70	-0.96	-9.24	6.68
Missouri	Pettis	29159	3.72	2.68	4.90	-4.29	-10.75	4.40
Missouri	Phelps	29161	4.04	2.96	5.30	-4.00	-10.44	3.80
Missouri	Pike	29163	3.77	2.68	5.07	0.11	-8.66	15.45
Missouri	Platte	29165	2.74	1.93	3.58	-3.20	-10.84	4.49
Missouri	Polk	29167	3.18	2.14	4.82	-2.71	-11.06	6.04
Missouri	Pulaski	29169	4.04	2.95	5.94	-3.78	-9.94	6.79
Missouri	Putnam	29171	2.68	2.00	3.64	-5.48	-12.27	3.49
Missouri	Ralls	29173	4.02	2.96	5.33	-0.11	-9.40	11.76

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State	County	FIPS	2017 Rate per 100,000 rate	95% CI		2013-2017 AAPC AAPC	95% CI	
Missouri	Randolph	29175	4.00	2.84	5.24	-2.93	-8.41	5.99
Missouri	Ray	29177	*	*	*	*	*	*
Missouri	Reynolds	29179	3.67	2.66	4.83	-2.08	-10.18	5.48
Missouri	Ripley	29181	4.72	3.36	6.63	1.47	-7.81	10.07
Missouri	St. Charles	29183	1.54	1.27	1.93	-4.12	-10.46	2.19
Missouri	St. Clair	29185	3.10	2.22	4.96	-3.12	-10.79	6.47
Missouri	Ste. Genevieve	29186	3.75	2.45	5.72	-0.88	-8.41	7.48
Missouri	St. Francois	29187	4.53	3.31	6.58	-4.08	-11.74	4.46
Missouri	St. Louis	29189	2.18	1.82	2.74	-5.70	-10.03	0.79
Missouri	Saline	29195	3.97	2.63	5.63	-3.68	-13.04	5.20
Missouri	Schuyler	29197	2.26	1.70	3.11	-4.10	-11.88	4.71
Missouri	Scotland	29199	3.56	2.56	4.78	-6.36	-14.76	1.31
Missouri	Scott	29201	2.98	2.14	4.00	-7.06	-14.73	0.54
Missouri	Shannon	29203	3.42	2.72	5.63	-1.34	-8.69	7.99
Missouri	Shelby	29205	3.40	2.18	4.51	-3.73	-13.87	6.02
Missouri	Stoddard	29207	2.79	1.81	3.95	-4.54	-12.95	2.22
Missouri	Stone	29209	2.72	1.61	3.83	-5.90	-14.99	2.65
Missouri	Sullivan	29211	3.77	2.56	5.05	-5.99	-11.68	2.08
Missouri	Taney	29213	*	*	*	*	*	*
Missouri	Texas	29215	3.81	2.98	4.71	-1.82	-9.26	5.71
Missouri	Vernon	29217	3.56	2.64	4.92	-3.43	-13.17	4.89
Missouri	Warren	29219	2.67	2.05	4.28	-2.36	-10.63	6.14
Missouri	Washington	29221	4.08	2.68	5.44	-2.32	-10.44	5.69
Missouri	Wayne	29223	3.19	2.19	4.17	-2.56	-9.95	4.73
Missouri	Webster	29225	4.02	2.35	5.61	-2.63	-9.85	6.85
Missouri	Worth	29227	3.52	2.32	4.76	-5.14	-13.87	6.83
Missouri	Wright	29229	5.29	3.55	8.68	-2.52	-11.19	9.03
Missouri	St. Louis City	29510	5.81	4.65	7.92	-9.94	-14.21	-3.21
Montana	Beaverhead	30001	3.35	2.25	4.25	-7.00	-13.92	-1.08
Montana	Big Horn	30003	5.15	3.97	6.67	0.95	-6.03	9.55
Montana	Blaine	30005	5.71	4.23	7.07	-2.28	-10.85	5.18
Montana	Broadwater	30007	3.10	1.93	4.18	-4.14	-11.15	4.54
Montana	Carbon	30009	3.38	2.44	5.26	-1.85	-8.09	7.24
Montana	Carter	30011	3.30	2.55	4.28	-3.77	-12.30	4.03
Montana	Cascade	30013	4.55	3.22	7.63	-6.01	-13.71	5.64
Montana	Chouteau	30015	3.99	2.90	5.43	-5.32	-12.20	1.46
Montana	Custer	30017	3.76	2.76	5.09	-3.39	-12.09	4.38
Montana	Daniels	30019	2.58	1.76	3.72	-5.29	-13.63	5.99
Montana	Dawson	30021	2.68	1.80	4.18	-8.10	-15.78	-1.20
Montana	Deer Lodge	30023	*	*	*	*	*	*

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			2017 Rate per 100,000			2013-2017 AAPC		
State	**County**	**FIPS**	**rate**	**95% CI**		**AAPC**	**95% CI**	
Montana	Fallon	30025	3.10	2.31	4.40	-3.20	-12.09	4.99
Montana	Fergus	30027	3.29	2.62	4.59	-4.29	-10.17	1.88
Montana	Flathead	30029	3.19	2.42	4.00	-5.09	-12.71	1.61
Montana	Gallatin	30031	2.64	2.03	3.33	-4.61	-10.91	2.52
Montana	Garfield	30033	2.89	2.07	4.85	-4.25	-11.02	4.71
Montana	Glacier	30035	5.05	3.69	6.86	-3.77	-12.62	4.49
Montana	Golden Valley	30037	3.48	2.21	5.01	-2.79	-11.20	7.14
Montana	Granite	30039	3.45	2.23	4.95	-9.41	-20.36	1.42
Montana	Hill	30041	4.49	3.36	6.17	-2.76	-11.22	4.67
Montana	Jefferson	30043	3.70	2.70	4.80	-6.34	-14.35	1.49
Montana	Judith Basin	30045	3.49	1.84	4.84	-5.54	-13.47	2.57
Montana	Lake	30047	*	*	*	*	*	*
Montana	Lewis and Clark	30049	4.31	3.17	5.52	-6.40	-14.68	0.87
Montana	Liberty	30051	3.58	2.62	5.04	-7.08	-16.61	3.75
Montana	Lincoln	30053	3.73	2.58	6.05	-4.10	-10.83	3.69
Montana	McCone	30055	3.60	2.61	5.79	-6.02	-13.24	2.39
Montana	Madison	30057	2.43	1.55	3.48	-4.82	-13.09	4.56
Montana	Meagher	30059	*	*	*	*	*	*
Montana	Mineral	30061	4.43	2.96	6.97	-6.47	-13.97	4.59
Montana	Missoula	30063	3.80	2.61	4.84	-7.10	-14.47	0.35
Montana	Musselshell	30065	3.69	2.77	5.03	-3.73	-12.98	6.32
Montana	Park	30067	4.42	3.06	5.88	-7.50	-13.44	3.89
Montana	Petroleum	30069	2.81	1.86	3.93	-4.34	-11.90	3.95
Montana	Phillips	30071	3.76	2.89	5.20	-4.41	-12.40	5.62
Montana	Pondera	30073	*	*	*	*	*	*
Montana	Powder River	30075	3.41	2.65	4.92	-0.15	-7.12	8.92
Montana	Powell	30077	*	*	*	*	*	*
Montana	Prairie	30079	3.71	2.75	4.74	-6.36	-13.29	1.74
Montana	Ravalli	30081	3.35	2.22	4.43	-9.34	-15.40	0.62
Montana	Richland	30083	3.18	2.35	4.29	-7.66	-14.82	1.23
Montana	Roosevelt	30085	4.08	3.35	5.05	-2.73	-8.51	3.73
Montana	Rosebud	30087	4.39	3.41	5.13	-2.48	-9.03	4.43
Montana	Sanders	30089	4.68	3.00	6.57	-6.80	-13.10	1.24
Montana	Sheridan	30091	3.83	2.66	5.54	-3.65	-12.40	6.19
Montana	Silver Bow	30093	3.96	2.61	5.64	-9.99	-17.72	-3.30
Montana	Stillwater	30095	3.84	2.84	5.44	-4.32	-13.72	5.58
Montana	Sweet Grass	30097	*	*	*	*	*	*
Montana	Teton	30099	3.55	2.12	4.77	-3.35	-12.25	6.03
Montana	Toole	30101	*	*	*	*	*	*
Montana	Treasure	30103	*	*	*	*	*	*

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			2017 Rate per 100,000			2013-2017 AAPC		
State	**County**	**FIPS**	**rate**	**95% CI**		**AAPC**	**95% CI**	
Montana	Valley	30105	3.49	2.21	5.21	-5.20	-13.86	4.84
Montana	Wheatland	30107	3.50	1.92	4.96	-4.75	-12.95	3.87
Montana	Wibaux	30109	3.33	2.50	4.71	-6.96	-14.05	0.83
Montana	Yellowstone	30111	5.04	3.90	7.07	-0.09	-8.43	7.80
Nebraska	Adams	31001	2.50	1.87	3.22	-1.61	-9.96	7.32
Nebraska	Antelope	31003	2.80	2.28	4.02	-6.59	-12.20	5.29
Nebraska	Arthur	31005	*	*	*	*	*	*
Nebraska	Banner	31007	3.73	2.63	5.60	0.78	-10.24	8.34
Nebraska	Blaine	31009	2.73	2.01	4.05	-1.30	-8.98	7.50
Nebraska	Boone	31011	2.27	1.64	3.23	-7.90	-16.36	-0.19
Nebraska	Box Butte	31013	3.59	2.62	4.88	0.49	-7.78	7.71
Nebraska	Boyd	31015	2.79	2.02	3.68	-3.60	-11.35	6.05
Nebraska	Brown	31017	2.20	1.62	3.00	-0.91	-9.25	6.03
Nebraska	Buffalo	31019	2.50	1.97	3.21	1.27	-6.80	9.31
Nebraska	Burt	31021	2.66	1.94	3.52	-5.11	-11.50	4.70
Nebraska	Butler	31023	2.71	2.05	3.89	-2.51	-10.12	3.79
Nebraska	Cass	31025	3.02	2.26	5.04	0.49	-5.66	9.79
Nebraska	Cedar	31027	*	*	*	*	*	*
Nebraska	Chase	31029	4.06	2.37	5.91	-0.54	-13.34	9.15
Nebraska	Cherry	31031	2.54	1.84	3.58	-2.13	-7.95	4.03
Nebraska	Cheyenne	31033	*	*	*	*	*	*
Nebraska	Clay	31035	2.33	1.64	3.31	-3.17	-11.99	3.77
Nebraska	Colfax	31037	2.47	1.76	3.41	-3.31	-11.23	5.04
Nebraska	Cuming	31039	2.55	1.71	3.56	-6.17	-15.25	2.89
Nebraska	Custer	31041	2.62	1.97	3.41	-1.20	-8.62	7.51
Nebraska	Dakota	31043	3.72	2.63	5.80	-6.52	-14.33	4.61
Nebraska	Dawes	31045	3.61	2.38	5.27	3.33	-4.38	13.52
Nebraska	Dawson	31047	3.43	2.68	4.38	0.48	-6.66	7.91
Nebraska	Deuel	31049	*	*	*	*	*	*
Nebraska	Dixon	31051	*	*	*	*	*	*
Nebraska	Dodge	31053	2.97	1.98	3.94	-5.44	-13.87	2.27
Nebraska	Douglas	31055	5.63	4.64	6.80	-2.78	-7.64	2.74
Nebraska	Dundy	31057	3.52	2.41	5.05	-2.02	-10.80	7.13
Nebraska	Fillmore	31059	2.78	2.12	3.73	-4.07	-15.08	3.00
Nebraska	Franklin	31061	3.60	2.37	5.31	-0.77	-8.62	6.59
Nebraska	Frontier	31063	3.66	2.85	4.54	-0.52	-10.04	8.82
Nebraska	Furnas	31065	3.50	2.50	5.48	2.09	-7.57	12.75
Nebraska	Gage	31067	2.33	1.54	3.21	-1.52	-8.43	5.67
Nebraska	Garden	31069	3.45	2.32	5.04	-0.03	-5.97	7.41
Nebraska	Garfield	31071	1.86	1.29	2.91	-1.09	-9.26	6.49

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State	County	FIPS	2017 Rate per 100,000 rate	95% CI		2013-2017 AAPC AAPC	95% CI	
Nebraska	Gosper	31073	*	*	*	*	*	*
Nebraska	Grant	31075	*	*	*	*	*	*
Nebraska	Greeley	31077	*	*	*	*	*	*
Nebraska	Hall	31079	3.32	2.25	4.72	-3.34	-11.26	5.17
Nebraska	Hamilton	31081	2.30	1.59	3.29	-3.79	-11.39	3.83
Nebraska	Harlan	31083	*	*	*	*	*	*
Nebraska	Hayes	31085	4.14	2.82	6.64	-0.22	-8.31	9.68
Nebraska	Hitchcock	31087	4.19	3.24	5.97	-0.58	-9.20	9.06
Nebraska	Holt	31089	2.76	2.04	3.60	-2.99	-10.91	6.79
Nebraska	Hooker	31091	3.43	2.61	4.61	-4.64	-12.37	4.30
Nebraska	Howard	31093	3.01	2.15	4.72	-3.33	-11.46	6.16
Nebraska	Jefferson	31095	2.98	1.99	4.23	-4.16	-14.30	5.00
Nebraska	Johnson	31097	3.11	2.08	4.68	-1.30	-9.20	7.09
Nebraska	Kearney	31099	2.78	2.03	4.47	-0.32	-10.48	7.36
Nebraska	Keith	31101	3.89	2.94	5.52	-0.94	-7.64	7.05
Nebraska	Keya Paha	31103	2.18	1.61	2.77	-0.75	-7.45	7.37
Nebraska	Kimball	31105	3.80	2.63	5.48	-0.94	-9.94	9.01
Nebraska	Knox	31107	3.11	2.41	4.27	-4.48	-12.27	6.95
Nebraska	Lancaster	31109	3.19	2.53	4.08	-0.60	-7.16	4.92
Nebraska	Lincoln	31111	4.11	3.15	5.46	-2.04	-8.39	6.45
Nebraska	Logan	31113	4.11	2.73	6.03	-2.47	-11.41	6.84
Nebraska	Loup	31115	2.52	1.75	3.66	-2.06	-9.11	5.70
Nebraska	McPherson	31117	3.86	2.57	5.80	-3.08	-12.29	5.90
Nebraska	Madison	31119	2.57	1.92	3.60	-7.25	-15.01	0.95
Nebraska	Merrick	31121	2.66	1.92	3.76	-4.31	-10.23	6.12
Nebraska	Morrill	31123	4.11	2.89	5.67	-0.66	-7.34	7.06
Nebraska	Nance	31125	2.24	1.64	3.58	-5.98	-17.29	2.09
Nebraska	Nemaha	31127	3.16	2.18	5.02	-1.83	-9.45	7.71
Nebraska	Nuckolls	31129	2.67	1.93	3.82	-4.95	-15.01	2.84
Nebraska	Otoe	31131	3.10	2.40	4.31	-0.13	-6.25	7.36
Nebraska	Pawnee	31133	3.44	2.49	4.72	-1.58	-8.86	6.71
Nebraska	Perkins	31135	3.34	2.10	4.96	0.41	-9.98	8.55
Nebraska	Phelps	31137	2.96	2.24	3.85	0.89	-4.99	9.12
Nebraska	Pierce	31139	3.41	2.51	5.00	-6.36	-16.39	6.26
Nebraska	Platte	31141	2.25	1.47	3.04	-5.44	-14.32	2.69
Nebraska	Polk	31143	2.50	1.91	3.21	-4.61	-10.09	5.98
Nebraska	Red Willow	31145	3.36	2.44	4.86	-1.68	-10.87	8.75
Nebraska	Richardson	31147	2.82	2.12	3.69	-1.37	-9.50	5.67
Nebraska	Rock	31149	2.37	1.46	3.38	-1.71	-9.63	8.65
Nebraska	Saline	31151	2.18	1.60	3.01	-3.88	-10.22	3.79

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State	County	FIPS	2017 Rate per 100,000 rate	95% CI		2013-2017 AAPC AAPC	95% CI	
Nebraska	Sarpy	31153	2.45	1.92	3.06	-0.94	-7.44	5.38
Nebraska	Saunders	31155	*	*	*	*	*	*
Nebraska	Scotts Bluff	31157	3.34	2.33	4.43	0.77	-10.09	11.22
Nebraska	Seward	31159	2.40	1.93	3.65	-3.97	-10.54	1.90
Nebraska	Sheridan	31161	3.14	2.36	4.29	0.89	-6.36	8.34
Nebraska	Sherman	31163	2.97	2.24	4.10	-1.81	-10.73	10.79
Nebraska	Sioux	31165	4.86	3.74	6.97	0.40	-9.49	11.06
Nebraska	Stanton	31167	2.54	1.78	3.48	-5.53	-12.02	1.82
Nebraska	Thayer	31169	2.10	1.58	3.14	-3.81	-11.12	4.32
Nebraska	Thomas	31171	*	*	*	*	*	*
Nebraska	Thurston	31173	3.32	2.30	4.55	-5.50	-14.06	1.02
Nebraska	Valley	31175	*	*	*	*	*	*
Nebraska	Washington	31177	2.72	2.02	4.01	-3.62	-10.51	5.61
Nebraska	Wayne	31179	2.69	2.01	3.42	-8.65	-16.95	1.48
Nebraska	Webster	31181	2.74	1.97	4.07	-0.73	-8.26	8.15
Nebraska	Wheeler	31183	2.27	1.67	3.27	-3.20	-11.97	12.13
Nebraska	York	31185	2.64	2.00	3.94	-4.43	-11.42	2.72
Nevada	Churchill	32001	3.98	2.78	6.07	-6.31	-13.32	3.41
Nevada	Clark	32003	3.80	3.33	4.32	-5.99	-10.19	-1.80
Nevada	Douglas	32005	3.61	2.58	5.18	-7.86	-14.60	0.71
Nevada	Elko	32007	3.76	2.82	4.93	-2.74	-12.89	5.15
Nevada	Esmeralda	32009	3.82	2.80	5.95	-4.61	-14.26	4.50
Nevada	Eureka	32011	5.48	3.72	7.89	-5.24	-15.17	2.90
Nevada	Humboldt	32013	5.82	3.84	7.43	-7.38	-16.64	-0.01
Nevada	Lander	32015	4.21	2.68	6.86	-6.83	-14.57	0.07
Nevada	Lincoln	32017	4.21	3.23	5.70	-6.26	-14.65	2.23
Nevada	Lyon	32019	4.72	3.55	6.18	-8.61	-16.47	-2.38
Nevada	Mineral	32021	4.39	3.06	6.26	-5.36	-12.70	3.52
Nevada	Nye	32023	5.83	4.46	7.79	-8.31	-14.77	-0.53
Nevada	Pershing	32027	4.72	3.45	6.63	-4.90	-12.48	3.52
Nevada	Storey	32029	6.75	4.57	9.94	-7.19	-17.75	2.35
Nevada	Washoe	32031	6.53	5.60	8.04	-11.67	-16.13	-5.30
Nevada	White Pine	32033	4.76	3.52	6.71	-5.92	-14.78	1.46
Nevada	Carson City	32510	7.21	5.07	10.31	-10.21	-19.30	-1.54
New Hampshire	Belknap	33001	3.41	2.54	4.43	-5.66	-12.13	2.86
New Hampshire	Carroll	33003	*	*	*	*	*	*
New Hampshire	Cheshire	33005	3.21	2.29	4.20	-3.73	-11.95	4.18
New Hampshire	Coos	33007	2.88	2.00	4.53	-9.67	-19.71	-0.98
New Hampshire	Grafton	33009	3.35	2.65	4.50	-7.12	-12.89	-1.60
New Hampshire	Hillsborough	33011	3.07	2.51	3.70	-5.55	-11.39	0.28

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State	County	FIPS	2017 Rate per 100,000 rate	95% CI		2013-2017 AAPC AAPC	95% CI	
New Hampshire	Merrimack	33013	3.40	2.58	4.77	-6.36	-13.08	2.31
New Hampshire	Rockingham	33015	2.01	1.38	2.67	-7.66	-17.77	-0.94
New Hampshire	Strafford	33017	2.78	2.12	3.64	-9.00	-16.54	-0.95
New Hampshire	Sullivan	33019	4.36	3.29	5.62	-6.49	-12.57	1.99
New Jersey	Atlantic	34001	4.56	3.57	5.58	-10.32	-17.05	-4.68
New Jersey	Bergen	34003	1.73	1.39	2.13	-9.09	-15.01	-4.05
New Jersey	Burlington	34005	2.51	2.04	3.02	-6.21	-11.16	-0.50
New Jersey	Camden	34007	4.46	3.67	5.33	-6.01	-10.93	-0.99
New Jersey	Cape May	34009	4.29	3.00	5.76	-16.68	-26.70	-5.75
New Jersey	Cumberland	34011	6.03	4.39	8.03	-11.72	-20.09	-5.94
New Jersey	Essex	34013	4.70	3.90	5.72	-6.87	-12.45	-1.66
New Jersey	Gloucester	34015	2.97	2.24	3.69	-9.42	-15.56	-4.86
New Jersey	Hudson	34017	4.52	3.66	5.53	-6.64	-12.07	-0.24
New Jersey	Hunterdon	34019	2.07	1.61	2.76	-6.45	-13.09	0.66
New Jersey	Mercer	34021	4.64	3.60	5.46	-7.68	-13.34	-2.18
New Jersey	Middlesex	34023	1.88	1.49	2.49	-11.93	-17.27	-5.26
New Jersey	Monmouth	34025	2.27	1.70	2.87	-7.93	-14.74	-1.49
New Jersey	Morris	34027	1.62	1.28	1.96	-5.01	-9.49	1.15
New Jersey	Ocean	34029	2.33	1.87	3.07	-7.51	-14.79	2.00
New Jersey	Passaic	34031	4.01	3.35	4.90	-4.61	-9.19	0.80
New Jersey	Salem	34033	3.40	2.36	5.09	-9.89	-21.20	-0.84
New Jersey	Somerset	34035	2.39	1.81	3.15	-4.19	-10.70	1.38
New Jersey	Sussex	34037	2.70	2.15	3.33	-4.94	-11.63	1.96
New Jersey	Union	34039	2.71	2.18	3.60	-6.64	-12.74	1.14
New Jersey	Warren	34041	2.94	2.20	3.87	-3.57	-9.94	3.69
New Mexico	Bernalillo	35001	7.85	6.46	9.22	-8.17	-13.82	-2.82
New Mexico	Catron	35003	4.56	3.02	6.20	-4.99	-13.66	4.55
New Mexico	Chaves	35005	10.46	7.55	14.68	-2.51	-12.76	5.07
New Mexico	Colfax	35007	*	*	*	*	*	*
New Mexico	Curry	35009	5.62	4.41	7.23	-0.50	-7.46	7.58
New Mexico	De Baca	35011	6.34	3.60	8.06	-3.53	-14.31	5.07
New Mexico	Dona Ana	35013	6.43	4.87	8.44	-1.21	-8.08	8.14
New Mexico	Eddy	35015	7.45	5.03	10.03	-1.40	-9.22	6.92
New Mexico	Grant	35017	7.05	4.63	10.15	-0.52	-14.74	12.04
New Mexico	Guadalupe	35019	*	*	*	*	*	*
New Mexico	Harding	35021	7.22	4.86	11.57	-7.76	-17.62	4.48
New Mexico	Hidalgo	35023	*	*	*	*	*	*
New Mexico	Lea	35025	6.94	5.72	8.58	-0.08	-7.34	9.66
New Mexico	Lincoln	35027	6.01	4.46	7.88	-5.25	-15.80	2.36
New Mexico	Los Alamos	35028	3.16	2.34	5.36	-4.76	-14.97	3.57

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			2017 Rate per 100,000			2013-2017 AAPC		
State	**County**	**FIPS**	**rate**	**95% CI**		**AAPC**	**95% CI**	
New Mexico	Luna	35029	5.28	3.82	7.04	-1.92	-12.82	11.65
New Mexico	McKinley	35031	4.63	2.97	6.18	-7.94	-16.10	-0.68
New Mexico	Mora	35033	7.33	4.83	10.76	-9.88	-18.09	2.40
New Mexico	Otero	35035	6.48	5.28	8.09	-1.24	-9.23	5.80
New Mexico	Quay	35037	7.30	5.28	9.32	-5.82	-13.52	1.84
New Mexico	Rio Arriba	35039	9.79	6.70	12.78	-11.07	-18.47	-4.74
New Mexico	Roosevelt	35041	5.95	4.06	7.56	-0.57	-9.37	8.13
New Mexico	Sandoval	35043	4.61	3.44	5.91	-7.88	-13.05	-1.23
New Mexico	San Juan	35045	4.54	3.30	5.79	-5.60	-10.83	-0.29
New Mexico	San Miguel	35047	8.35	5.24	11.90	-9.94	-18.59	0.35
New Mexico	Santa Fe	35049	5.09	3.86	6.55	-8.75	-15.71	-0.40
New Mexico	Sierra	35051	5.67	3.76	7.32	-4.34	-13.71	5.45
New Mexico	Socorro	35053	5.80	4.08	8.62	-7.86	-17.47	4.92
New Mexico	Taos	35055	6.13	4.17	9.67	-9.56	-18.33	-1.34
New Mexico	Torrance	35057	5.57	4.20	7.78	-8.60	-15.27	0.79
New Mexico	Union	35059	4.50	3.22	6.24	-6.08	-14.05	4.23
New Mexico	Valencia	35061	8.82	6.99	10.83	-6.40	-10.98	-1.40
New York	Albany	36001	3.31	2.69	4.23	-7.64	-11.96	-2.42
New York	Allegany	36003	1.78	1.29	2.33	-3.20	-10.01	3.55
New York	Broome	36007	3.58	2.80	4.96	-4.58	-10.32	2.09
New York	Cattaraugus	36009	1.58	1.18	2.14	-6.37	-13.46	1.39
New York	Cayuga	36011	2.35	1.36	3.12	-7.30	-14.45	0.94
New York	Chautauqua	36013	2.26	1.74	3.07	-5.74	-13.85	2.01
New York	Chemung	36015	2.61	1.96	3.27	-4.71	-10.12	2.66
New York	Chenango	36017	1.93	1.38	2.64	-5.61	-13.41	3.14
New York	Clinton	36019	*	*	*	*	*	*
New York	Columbia	36021	2.59	1.99	3.27	-7.60	-13.30	-1.17
New York	Cortland	36023	2.75	1.92	3.83	-5.31	-13.17	3.39
New York	Delaware	36025	2.90	2.31	3.79	-6.34	-14.32	0.64
New York	Dutchess	36027	2.43	1.94	2.98	-7.86	-12.16	-2.21
New York	Erie	36029	2.92	2.48	3.68	-8.95	-13.86	-3.13
New York	Essex	36031	3.23	2.19	5.15	-4.37	-13.21	7.48
New York	Franklin	36033	2.37	1.64	3.65	-4.13	-13.90	3.65
New York	Fulton	36035	*	*	*	*	*	*
New York	Genesee	36037	1.88	1.24	2.45	-7.82	-14.36	-0.59
New York	Greene	36039	3.71	2.73	4.91	-7.89	-13.54	0.88
New York	Hamilton	36041	2.51	1.88	3.26	-3.70	-11.89	3.51
New York	Herkimer	36043	2.59	1.88	3.31	-6.21	-13.85	0.73
New York	Jefferson	36045	2.34	1.46	3.20	-3.08	-11.83	7.27
New York	Lewis	36049	*	*	*	*	*	*

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			2017 Rate per 100,000			2013-2017 AAPC		
State	**County**	**FIPS**	**rate**	**95% CI**		**AAPC**	**95% CI**	
New York	Livingston	36051	1.51	1.03	2.10	-6.78	-12.34	0.82
New York	Madison	36053	1.73	1.04	2.44	-4.79	-13.19	4.14
New York	Monroe	36055	1.96	1.43	2.52	-9.40	-16.12	-3.66
New York	Montgomery	36057	2.44	1.68	3.72	-4.57	-11.38	4.02
New York	Nassau	36059	1.33	0.93	1.74	-13.85	-20.71	-6.35
New York	Niagara	36063	2.18	1.60	3.16	-6.21	-13.21	2.32
New York	Oneida	36065	3.09	2.56	4.04	-5.48	-12.07	0.54
New York	Onondaga	36067	2.66	1.93	3.45	-6.73	-14.52	2.03
New York	Ontario	36069	1.55	1.09	2.27	-7.85	-13.77	-1.84
New York	Orange	36071	2.70	2.24	3.31	-7.57	-12.28	-1.52
New York	Orleans	36073	1.51	1.04	2.40	-7.46	-14.47	0.53
New York	Oswego	36075	1.47	0.85	2.24	-3.10	-11.49	5.81
New York	Otsego	36077	2.38	1.69	3.20	-6.07	-13.88	1.79
New York	Putnam	36079	1.69	1.27	2.55	-8.83	-16.43	-0.98
New York	Rensselaer	36083	2.71	2.07	3.48	-4.95	-11.46	0.59
New York	Rockland	36087	1.87	1.46	2.47	-9.88	-16.09	-4.28
New York	St. Lawrence	36089	2.28	1.42	3.33	-7.70	-16.98	1.38
New York	Saratoga	36091	2.37	1.75	3.10	-4.11	-10.04	3.30
New York	Schenectady	36093	2.40	1.74	3.30	-5.59	-14.80	3.55
New York	Schoharie	36095	2.81	2.03	3.78	-6.50	-15.03	1.72
New York	Schuyler	36097	2.10	1.30	2.96	-5.20	-13.20	2.30
New York	Seneca	36099	2.02	1.56	2.59	-7.47	-14.71	-0.06
New York	Steuben	36101	2.20	1.55	2.79	-6.70	-12.36	-0.73
New York	Suffolk	36103	1.75	1.32	2.24	-9.78	-17.78	-2.80
New York	Sullivan	36105	3.89	2.94	5.04	-8.31	-13.80	-2.03
New York	Tioga	36107	2.64	1.84	3.94	-2.02	-10.62	7.94
New York	Tompkins	36109	2.41	1.79	3.31	-3.90	-10.02	2.79
New York	Ulster	36111	3.15	2.51	4.11	-6.72	-12.80	-0.11
New York	Warren	36113	3.28	2.23	4.45	-4.95	-14.64	6.28
New York	Washington	36115	3.03	2.03	4.24	-5.10	-11.82	3.18
New York	Wayne	36117	1.59	1.18	2.26	-6.71	-14.87	3.06
New York	Westchester	36119	1.98	1.63	2.45	-11.03	-15.54	-5.55
New York	Wyoming	36121	*	*	*	*	*	*
New York	Yates	36123	1.76	1.33	2.48	-6.77	-16.58	1.41
New York	Bronx	36999	4.19	3.86	4.54	-13.94	-16.00	-11.86
North Carolina	Alamance	37001	3.53	2.61	4.44	-6.19	-12.84	0.46
North Carolina	Alexander	37003	*	*	*	*	*	*
North Carolina	Alleghany	37005	*	*	*	*	*	*
North Carolina	Anson	37007	3.80	2.78	5.92	-3.06	-9.16	4.43
North Carolina	Ashe	37009	3.58	2.76	6.18	-1.52	-12.41	7.83

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			2017 Rate per 100,000			2013-2017 AAPC		
State	**County**	**FIPS**	**rate**	**95% CI**		**AAPC**	**95% CI**	
North Carolina	Avery	37011	5.11	3.68	7.20	-3.09	-10.91	4.08
North Carolina	Beaufort	37013	4.41	3.06	5.67	-6.21	-12.89	-0.24
North Carolina	Bertie	37015	3.29	2.23	5.05	-3.57	-12.63	4.21
North Carolina	Bladen	37017	4.81	3.87	6.49	-3.20	-8.96	5.52
North Carolina	Brunswick	37019	3.58	2.67	4.76	-7.84	-14.68	0.95
North Carolina	Buncombe	37021	6.92	5.71	8.28	-1.82	-7.25	4.86
North Carolina	Burke	37023	4.35	3.51	5.67	-4.71	-10.60	2.50
North Carolina	Cabarrus	37025	3.71	2.99	4.57	-4.83	-12.02	1.83
North Carolina	Caldwell	37027	4.57	3.41	6.22	-4.49	-13.81	3.21
North Carolina	Camden	37029	3.10	1.84	4.37	-0.80	-8.42	10.59
North Carolina	Carteret	37031	4.07	2.69	5.66	-7.84	-15.46	1.05
North Carolina	Caswell	37033	3.67	3.05	4.68	-5.00	-10.65	2.77
North Carolina	Catawba	37035	3.76	3.00	4.88	-4.69	-12.46	3.39
North Carolina	Chatham	37037	2.60	2.06	3.20	-6.07	-11.63	0.30
North Carolina	Cherokee	37039	5.95	4.28	7.83	-3.69	-10.73	4.29
North Carolina	Chowan	37041	*	*	*	*	*	*
North Carolina	Clay	37043	5.98	3.68	8.82	-2.97	-13.18	7.34
North Carolina	Cleveland	37045	3.90	3.04	5.13	-3.69	-9.30	2.18
North Carolina	Columbus	37047	4.11	3.03	5.18	-1.37	-7.71	5.80
North Carolina	Craven	37049	3.74	2.70	4.93	-7.70	-13.31	0.89
North Carolina	Cumberland	37051	6.05	4.95	7.40	-1.16	-6.01	5.77
North Carolina	Currituck	37053	2.71	1.92	3.85	-2.56	-10.65	8.13
North Carolina	Dare	37055	*	*	*	*	*	*
North Carolina	Davidson	37057	3.18	2.35	4.56	-5.03	-11.85	1.52
North Carolina	Davie	37059	2.95	1.89	4.31	-5.01	-13.61	2.56
North Carolina	Duplin	37061	2.72	2.05	3.42	-4.39	-10.62	2.06
North Carolina	Durham	37063	3.89	2.99	5.05	-6.99	-11.74	-1.23
North Carolina	Edgecombe	37065	4.36	3.48	5.51	-4.30	-10.84	1.83
North Carolina	Forsyth	37067	3.69	2.91	4.34	-5.68	-9.56	-0.16
North Carolina	Franklin	37069	2.99	2.37	3.72	-7.24	-12.75	-0.05
North Carolina	Gaston	37071	6.19	4.96	7.85	-3.45	-9.92	3.17
North Carolina	Gates	37073	3.78	2.55	5.27	0.87	-5.15	9.97
North Carolina	Graham	37075	7.20	4.96	9.79	-2.78	-11.69	8.53
North Carolina	Granville	37077	3.82	2.99	4.80	-5.21	-11.89	3.64
North Carolina	Greene	37079	3.44	2.24	5.08	-7.10	-17.74	3.82
North Carolina	Guilford	37081	3.59	2.95	4.32	-6.90	-11.52	-1.28
North Carolina	Halifax	37083	3.39	2.72	4.46	-4.75	-12.56	1.13
North Carolina	Harnett	37085	3.44	2.74	4.31	-5.72	-11.72	1.48
North Carolina	Haywood	37087	4.50	3.08	5.79	0.13	-9.15	7.61
North Carolina	Henderson	37089	4.81	3.54	6.94	1.74	-7.43	9.56

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			2017 Rate per 100,000			2013-2017 AAPC		
State	**County**	**FIPS**	**rate**	**95% CI**		**AAPC**	**95% CI**	
North Carolina	Hertford	37091	2.85	1.95	4.00	-3.21	-12.22	4.92
North Carolina	Hoke	37093	3.65	2.98	4.72	-4.44	-9.73	1.42
North Carolina	Hyde	37095	3.77	2.64	5.28	-3.99	-13.22	2.81
North Carolina	Iredell	37097	3.76	2.97	4.59	-3.85	-9.19	2.60
North Carolina	Jackson	37099	4.40	3.60	5.39	-2.30	-8.90	4.32
North Carolina	Johnston	37101	2.43	1.98	2.99	-6.47	-12.08	0.71
North Carolina	Jones	37103	3.62	2.83	4.78	-5.51	-12.93	1.46
North Carolina	Lee	37105	3.25	2.55	4.28	-7.00	-14.03	2.50
North Carolina	Lenoir	37107	3.00	2.26	3.82	-4.97	-11.09	1.17
North Carolina	Lincoln	37109	3.73	2.99	5.49	-3.29	-9.87	5.46
North Carolina	McDowell	37111	5.20	3.60	7.17	-2.33	-10.26	4.62
North Carolina	Macon	37113	5.36	3.55	6.97	-0.41	-8.55	10.27
North Carolina	Madison	37115	4.83	3.39	7.03	0.28	-8.70	8.82
North Carolina	Martin	37117	4.31	3.23	5.85	-4.19	-10.59	1.67
North Carolina	Mecklenburg	37119	3.32	2.86	3.94	-4.17	-8.86	0.92
North Carolina	Mitchell	37121	5.38	3.70	7.49	0.63	-8.49	11.44
North Carolina	Montgomery	37123	3.25	2.42	4.28	-3.12	-9.83	5.08
North Carolina	Moore	37125	3.11	2.28	4.00	-4.37	-11.50	3.17
North Carolina	Nash	37127	3.49	2.68	4.49	-4.91	-10.86	0.73
North Carolina	New Hanover	37129	3.18	2.18	4.64	-10.58	-19.84	-0.40
North Carolina	Northampton	37131	3.51	2.77	4.62	-5.25	-11.02	4.48
North Carolina	Onslow	37133	3.40	2.54	4.32	-3.29	-10.98	4.52
North Carolina	Orange	37135	2.68	1.99	3.60	-5.59	-15.79	2.98
North Carolina	Pamlico	37137	*	*	*	*	*	*
North Carolina	Pasquotank	37139	4.62	3.49	6.18	1.82	-9.09	13.30
North Carolina	Pender	37141	3.41	2.70	4.38	-5.86	-11.50	2.31
North Carolina	Perquimans	37143	3.83	2.94	5.14	0.76	-9.85	11.64
North Carolina	Person	37145	3.23	2.58	4.62	-5.29	-12.07	4.49
North Carolina	Pitt	37147	4.92	4.05	6.07	-5.49	-10.96	0.71
North Carolina	Polk	37149	5.41	3.84	7.54	4.00	-4.26	13.04
North Carolina	Randolph	37151	3.82	2.60	5.11	-3.77	-11.73	4.18
North Carolina	Richmond	37153	3.88	2.88	5.69	-3.35	-9.01	5.02
North Carolina	Robeson	37155	5.86	4.79	7.18	-4.03	-9.39	1.96
North Carolina	Rockingham	37157	4.00	3.00	5.29	-4.35	-10.80	1.58
North Carolina	Rowan	37159	3.92	3.00	4.86	-6.87	-13.38	-0.14
North Carolina	Rutherford	37161	4.90	3.72	7.47	1.68	-5.36	9.24
North Carolina	Sampson	37163	3.91	3.09	5.10	-6.08	-10.62	-2.07
North Carolina	Scotland	37165	3.57	2.66	4.50	-2.38	-9.27	5.57
North Carolina	Stanly	37167	4.58	3.55	6.40	-0.25	-7.21	9.92
North Carolina	Stokes	37169	3.35	2.30	5.57	-4.60	-11.21	4.37

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State	County	FIPS	2017 Rate per 100,000 rate	95% CI		2013-2017 AAPC AAPC	95% CI	
North Carolina	Surry	37171	3.01	2.32	4.11	-3.46	-11.12	4.76
North Carolina	Swain	37173	*	*	*	*	*	*
North Carolina	Transylvania	37175	4.27	3.18	6.12	0.30	-6.92	7.33
North Carolina	Tyrrell	37177	3.76	2.24	5.93	-5.38	-21.11	7.71
North Carolina	Union	37179	2.56	2.07	3.40	-0.63	-6.79	5.75
North Carolina	Vance	37181	2.99	2.31	4.22	-4.81	-12.95	3.13
North Carolina	Wake	37183	2.50	2.07	3.01	-5.97	-11.21	-1.08
North Carolina	Warren	37185	2.58	1.71	4.01	-6.17	-11.41	0.46
North Carolina	Washington	37187	3.05	2.34	4.08	-4.17	-11.56	2.31
North Carolina	Watauga	37189	4.52	3.45	5.66	-5.46	-13.74	2.63
North Carolina	Wayne	37191	3.82	2.62	5.20	-6.21	-14.08	-0.33
North Carolina	Wilkes	37193	4.43	3.42	6.27	-3.60	-11.09	4.48
North Carolina	Wilson	37195	3.62	2.73	4.84	-6.96	-14.33	0.77
North Carolina	Yadkin	37197	3.19	2.44	4.46	-3.10	-10.22	5.38
North Carolina	Yancey	37199	6.57	4.47	9.73	0.13	-7.27	9.22
North Dakota	Adams	38001	3.07	1.87	3.92	-6.16	-16.69	2.26
North Dakota	Barnes	38003	2.20	1.48	3.42	-6.27	-14.62	2.70
North Dakota	Benson	38005	3.04	1.78	4.08	-0.78	-10.85	7.48
North Dakota	Billings	38007	*	*	*	*	*	*
North Dakota	Bottineau	38009	2.64	1.68	4.30	-3.94	-11.97	6.79
North Dakota	Bowman	38011	3.81	2.70	5.33	-4.97	-12.72	4.40
North Dakota	Burke	38013	2.78	1.68	4.24	-4.57	-12.31	4.35
North Dakota	Burleigh	38015	2.39	1.58	3.09	-5.68	-14.77	1.12
North Dakota	Cass	38017	2.12	1.56	3.44	-4.29	-12.18	3.29
North Dakota	Cavalier	38019	3.31	1.89	4.74	-0.71	-9.37	6.96
North Dakota	Dickey	38021	*	*	*	*	*	*
North Dakota	Divide	38023	*	*	*	*	*	*
North Dakota	Dunn	38025	3.53	2.81	4.91	-2.94	-9.68	4.55
North Dakota	Eddy	38027	3.06	2.21	4.59	-6.31	-13.84	3.18
North Dakota	Emmons	38029	2.73	1.92	4.57	-6.11	-12.79	1.13
North Dakota	Foster	38031	3.28	2.03	4.65	-7.71	-16.63	1.76
North Dakota	Golden Valley	38033	3.07	2.17	3.99	-5.93	-14.33	3.46
North Dakota	Grand Forks	38035	2.73	1.75	4.00	-3.90	-11.80	3.62
North Dakota	Grant	38037	2.74	1.91	4.17	-6.75	-13.87	4.17
North Dakota	Griggs	38039	*	*	*	*	*	*
North Dakota	Hettinger	38041	2.44	1.74	3.43	-3.92	-14.39	6.36
North Dakota	Kidder	38043	2.63	1.92	3.67	-8.26	-14.99	-0.71
North Dakota	LaMoure	38045	2.20	1.74	2.75	-7.32	-14.97	0.56
North Dakota	Logan	38047	*	*	*	*	*	*
North Dakota	McHenry	38049	3.52	2.35	5.16	-5.60	-11.61	4.28

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			2017 Rate per 100,000			2013-2017 AAPC		
State	**County**	**FIPS**	**rate**	**95% CI**		**AAPC**	**95% CI**	
North Dakota	McIntosh	38051	2.06	1.36	2.77	-6.98	-14.82	0.44
North Dakota	McKenzie	38053	3.53	2.55	4.52	-4.07	-11.43	1.63
North Dakota	McLean	38055	3.38	2.56	4.51	-4.36	-11.63	1.97
North Dakota	Mercer	38057	3.46	2.13	5.48	-3.75	-14.07	5.54
North Dakota	Morton	38059	2.54	1.92	3.61	-3.11	-15.96	5.69
North Dakota	Mountrail	38061	3.88	3.04	5.14	-3.38	-8.95	5.51
North Dakota	Nelson	38063	2.52	1.84	3.56	-3.12	-13.10	5.17
North Dakota	Oliver	38065	3.00	2.16	3.92	-4.06	-12.70	5.78
North Dakota	Pembina	38067	2.84	1.85	4.61	-2.95	-11.34	9.27
North Dakota	Pierce	38069	2.33	1.65	3.18	-3.89	-11.21	2.77
North Dakota	Ramsey	38071	2.81	2.11	4.04	-1.96	-12.71	9.59
North Dakota	Ransom	38073	2.18	1.36	2.90	-7.10	-13.33	0.40
North Dakota	Renville	38075	*	*	*	*	*	*
North Dakota	Richland	38077	2.52	1.94	3.72	-5.46	-11.33	3.67
North Dakota	Rolette	38079	5.05	3.81	6.84	-0.12	-9.55	9.08
North Dakota	Sargent	38081	2.46	1.91	3.48	-7.14	-14.60	1.01
North Dakota	Sheridan	38083	2.65	2.00	3.78	-8.27	-14.89	-2.49
North Dakota	Sioux	38085	3.52	2.27	4.91	-1.73	-9.84	8.20
North Dakota	Slope	38087	2.90	2.14	3.84	-2.79	-11.36	7.60
North Dakota	Stark	38089	2.48	1.82	3.26	-3.28	-10.59	4.35
North Dakota	Steele	38091	2.37	1.56	3.31	-4.23	-11.77	5.78
North Dakota	Stutsman	38093	2.65	1.92	3.48	-8.93	-16.82	2.78
North Dakota	Towner	38095	*	*	*	*	*	*
North Dakota	Traill	38097	1.87	1.35	2.88	-6.07	-17.19	6.77
North Dakota	Walsh	38099	3.25	1.85	4.38	-2.51	-11.51	6.45
North Dakota	Ward	38101	2.51	1.57	3.47	-5.53	-12.57	1.71
North Dakota	Wells	38103	3.17	2.33	4.73	-8.10	-14.82	3.91
North Dakota	Williams	38105	3.29	2.41	4.73	-3.60	-10.03	4.10
Ohio	Adams	39001	4.02	2.89	5.60	1.90	-7.00	13.24
Ohio	Allen	39003	2.81	2.13	3.76	-4.50	-9.72	3.61
Ohio	Ashland	39005	3.13	2.10	4.41	2.22	-5.70	11.04
Ohio	Ashtabula	39007	2.51	1.91	3.51	-2.84	-10.06	7.37
Ohio	Athens	39009	3.01	2.04	4.27	3.48	-5.47	12.07
Ohio	Auglaize	39011	1.80	1.33	2.53	-1.95	-9.21	7.76
Ohio	Belmont	39013	3.03	2.40	3.87	-0.58	-7.71	6.62
Ohio	Brown	39015	3.09	2.27	4.59	0.03	-6.61	8.11
Ohio	Butler	39017	2.89	2.24	3.67	-4.58	-10.02	1.34
Ohio	Carroll	39019	2.28	1.54	3.14	4.76	-4.71	13.99
Ohio	Champaign	39021	2.51	1.73	3.34	-3.03	-13.90	6.60
Ohio	Clark	39023	3.96	2.96	4.87	-4.47	-12.40	3.51

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			2017 Rate per 100,000			2013-2017 AAPC		
State	**County**	**FIPS**	**rate**	**95% CI**		**AAPC**	**95% CI**	
Ohio	Clermont	39025	3.23	2.64	3.98	0.59	-5.84	8.54
Ohio	Clinton	39027	*	*	*	*	*	*
Ohio	Columbiana	39029	2.70	2.07	3.55	-0.80	-9.60	5.25
Ohio	Coshocton	39031	3.25	2.34	4.65	4.11	-5.55	14.43
Ohio	Crawford	39033	2.50	1.78	3.72	-3.75	-10.85	4.96
Ohio	Cuyahoga	39035	4.90	4.12	5.60	-1.55	-7.06	2.90
Ohio	Darke	39037	3.01	2.25	4.69	-2.92	-10.09	3.96
Ohio	Defiance	39039	3.07	1.93	4.72	-1.84	-9.21	5.48
Ohio	Delaware	39041	1.90	1.47	2.48	0.18	-6.24	8.58
Ohio	Erie	39043	3.00	2.16	4.34	1.92	-10.04	13.37
Ohio	Fairfield	39045	2.83	2.17	3.57	2.92	-5.26	10.92
Ohio	Fayette	39047	3.21	2.48	4.17	-0.51	-9.77	6.87
Ohio	Franklin	39049	4.16	3.56	4.86	-1.06	-5.95	4.08
Ohio	Fulton	39051	2.47	1.80	3.63	-3.52	-11.87	5.44
Ohio	Gallia	39053	4.32	3.26	6.45	3.32	-4.44	16.05
Ohio	Geauga	39055	1.64	1.24	2.37	-0.06	-9.01	8.54
Ohio	Greene	39057	3.03	2.25	4.06	-4.12	-12.78	3.22
Ohio	Guernsey	39059	3.47	2.45	4.70	0.34	-6.95	8.20
Ohio	Hamilton	39061	3.65	3.09	4.35	-5.58	-11.06	-1.02
Ohio	Hancock	39063	2.14	1.53	3.06	-3.30	-8.77	4.41
Ohio	Hardin	39065	1.98	1.43	2.93	-3.05	-10.35	4.15
Ohio	Harrison	39067	2.73	2.13	3.70	3.16	-4.81	13.42
Ohio	Henry	39069	2.14	1.61	2.89	-1.61	-7.72	5.36
Ohio	Highland	39071	4.07	3.02	5.74	-1.19	-8.85	8.11
Ohio	Hocking	39073	3.58	2.57	4.72	2.62	-6.30	12.81
Ohio	Holmes	39075	3.17	2.35	4.29	5.47	-6.86	13.76
Ohio	Huron	39077	2.98	2.27	4.31	-1.50	-7.43	8.77
Ohio	Jackson	39079	4.26	2.94	6.22	2.48	-7.27	10.76
Ohio	Jefferson	39081	2.38	1.74	3.25	-1.70	-10.58	8.25
Ohio	Knox	39083	2.40	1.70	3.47	2.55	-5.11	12.65
Ohio	Lake	39085	1.92	1.26	2.57	-2.41	-13.62	5.88
Ohio	Lawrence	39087	6.92	5.44	10.87	1.87	-5.50	16.05
Ohio	Licking	39089	3.04	2.25	3.94	3.83	-2.87	10.88
Ohio	Logan	39091	2.23	1.67	3.01	-3.95	-13.38	4.87
Ohio	Lorain	39093	3.25	2.54	4.32	-0.12	-7.53	9.98
Ohio	Lucas	39095	5.90	4.85	7.24	-5.34	-10.82	0.09
Ohio	Madison	39097	3.06	2.17	4.08	-2.85	-10.64	4.58
Ohio	Mahoning	39099	3.59	2.80	4.54	-2.42	-7.77	4.53
Ohio	Marion	39101	2.52	1.85	3.43	-4.44	-13.25	3.89
Ohio	Medina	39103	2.16	1.56	2.99	1.44	-6.32	10.66

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			2017 Rate per 100,000			2013-2017 AAPC		
State	**County**	**FIPS**	**rate**	**95% CI**		**AAPC**	**95% CI**	
Ohio	Meigs	39105	2.74	1.95	3.89	5.46	-5.83	18.10
Ohio	Mercer	39107	1.80	1.24	2.53	-0.75	-8.89	8.93
Ohio	Miami	39109	2.45	1.85	3.78	-4.86	-13.06	4.70
Ohio	Monroe	39111	3.25	2.45	4.44	-1.14	-9.25	6.92
Ohio	Montgomery	39113	5.14	4.13	6.18	-5.79	-11.31	-1.21
Ohio	Morgan	39115	3.53	2.73	4.99	2.83	-7.76	14.68
Ohio	Morrow	39117	2.37	1.50	3.22	-1.13	-11.26	6.90
Ohio	Muskingum	39119	3.14	1.59	4.40	1.47	-8.09	9.90
Ohio	Noble	39121	3.47	2.71	4.68	-0.27	-8.75	7.44
Ohio	Ottawa	39123	*	*	*	*	*	*
Ohio	Paulding	39125	2.46	1.50	3.69	0.28	-7.09	8.97
Ohio	Perry	39127	3.02	2.06	3.74	4.37	-5.22	12.14
Ohio	Pickaway	39129	3.38	2.48	4.54	1.01	-9.52	8.67
Ohio	Pike	39131	3.90	2.55	5.30	2.29	-10.22	11.28
Ohio	Portage	39133	2.15	1.64	2.75	-2.45	-7.78	6.83
Ohio	Preble	39135	3.46	2.18	5.11	-2.23	-10.29	6.35
Ohio	Putnam	39137	1.98	1.33	3.09	-1.98	-8.61	5.29
Ohio	Richland	39139	3.46	2.65	4.66	-3.82	-9.98	6.67
Ohio	Ross	39141	3.63	2.64	4.66	-0.87	-12.64	7.16
Ohio	Sandusky	39143	3.25	2.16	4.70	3.07	-4.68	13.12
Ohio	Scioto	39145	9.52	6.86	12.94	4.48	-5.91	13.70
Ohio	Seneca	39147	2.20	1.45	3.37	-2.74	-10.00	7.03
Ohio	Shelby	39149	2.57	1.88	3.59	-2.52	-11.31	6.33
Ohio	Stark	39151	2.79	2.22	3.51	-2.66	-9.40	5.77
Ohio	Summit	39153	3.53	2.82	4.36	-1.55	-8.03	5.17
Ohio	Trumbull	39155	2.44	2.00	3.03	-1.10	-8.81	6.66
Ohio	Tuscarawas	39157	3.17	2.15	4.28	8.35	-3.40	16.79
Ohio	Union	39159	2.52	1.90	3.05	-2.93	-10.44	6.90
Ohio	Van Wert	39161	2.22	1.63	2.93	1.59	-6.15	9.68
Ohio	Vinton	39163	3.63	2.76	5.82	3.55	-4.52	13.63
Ohio	Warren	39165	2.38	1.77	3.49	-6.09	-12.65	1.38
Ohio	Washington	39167	2.99	1.82	4.21	1.18	-8.70	8.55
Ohio	Wayne	39169	2.75	2.13	3.78	3.07	-4.18	10.63
Ohio	Williams	39171	2.40	1.64	3.42	-1.81	-9.30	5.55
Ohio	Wood	39173	3.07	2.23	3.78	-0.04	-6.20	7.93
Ohio	Wyandot	39175	2.24	1.65	3.09	-4.86	-11.88	4.97
Oklahoma	Adair	40001	6.78	4.79	10.16	0.56	-5.92	6.62
Oklahoma	Alfalfa	40003	5.06	3.77	7.13	1.32	-5.80	9.88
Oklahoma	Atoka	40005	10.23	7.64	13.12	1.73	-5.45	9.87
Oklahoma	Beaver	40007	3.13	2.39	5.26	-2.52	-10.14	6.67

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State	County	FIPS	2017 Rate per 100,000 rate	95% CI		2013-2017 AAPC AAPC	95% CI	
Oklahoma	Beckham	40009	8.84	6.10	11.53	-1.42	-7.88	6.70
Oklahoma	Blaine	40011	*	*	*	*	*	*
Oklahoma	Bryan	40013	9.49	7.85	12.89	0.84	-6.20	7.87
Oklahoma	Caddo	40015	10.82	8.22	14.79	2.70	-4.75	9.48
Oklahoma	Canadian	40017	8.73	7.22	11.11	5.84	-2.43	12.42
Oklahoma	Carter	40019	13.25	10.53	18.30	0.83	-5.07	6.49
Oklahoma	Cherokee	40021	9.93	7.99	13.76	1.89	-4.28	10.25
Oklahoma	Choctaw	40023	8.28	6.30	11.13	3.01	-3.50	10.01
Oklahoma	Cimarron	40025	3.63	2.54	4.92	-6.38	-13.54	2.64
Oklahoma	Cleveland	40027	10.01	8.12	12.06	4.77	-2.11	10.78
Oklahoma	Coal	40029	*	*	*	*	*	*
Oklahoma	Comanche	40031	9.90	7.37	14.23	3.82	-2.21	12.09
Oklahoma	Cotton	40033	8.56	5.72	10.95	2.48	-4.99	10.89
Oklahoma	Craig	40035	6.72	5.22	8.54	-1.76	-9.81	6.71
Oklahoma	Creek	40037	12.19	9.74	15.32	5.57	-1.09	14.82
Oklahoma	Custer	40039	8.27	5.60	11.78	-0.55	-7.57	9.23
Oklahoma	Delaware	40041	7.29	5.16	9.47	-4.42	-11.02	3.60
Oklahoma	Dewey	40043	*	*	*	*	*	*
Oklahoma	Ellis	40045	4.30	3.19	7.10	-1.21	-10.24	8.46
Oklahoma	Garfield	40047	8.40	6.52	10.85	3.28	-6.74	10.65
Oklahoma	Garvin	40049	9.60	6.83	14.32	3.70	-4.59	12.66
Oklahoma	Grady	40051	10.26	8.20	13.96	3.96	-3.39	12.02
Oklahoma	Grant	40053	*	*	*	*	*	*
Oklahoma	Greer	40055	5.90	3.84	9.72	-3.65	-12.99	6.68
Oklahoma	Harmon	40057	5.33	3.80	7.42	-1.32	-9.38	6.91
Oklahoma	Harper	40059	3.73	2.74	4.97	-0.83	-7.90	6.93
Oklahoma	Haskell	40061	8.22	5.66	10.36	4.54	-4.42	14.04
Oklahoma	Hughes	40063	9.41	6.83	12.55	5.80	-3.45	13.59
Oklahoma	Jackson	40065	6.49	4.89	9.49	-2.23	-10.55	7.56
Oklahoma	Jefferson	40067	6.41	5.01	8.45	2.61	-5.35	10.55
Oklahoma	Johnston	40069	12.00	9.41	15.03	1.50	-4.78	7.91
Oklahoma	Kay	40071	9.07	7.19	12.53	2.09	-3.81	11.99
Oklahoma	Kingfisher	40073	7.66	4.94	9.63	5.09	-5.15	13.94
Oklahoma	Kiowa	40075	7.44	5.54	9.30	-0.72	-7.79	8.48
Oklahoma	Latimer	40077	8.40	6.42	12.00	4.26	-9.03	17.84
Oklahoma	Le Flore	40079	8.58	6.70	11.44	2.99	-4.94	9.02
Oklahoma	Lincoln	40081	10.58	8.24	16.87	4.99	-1.64	15.37
Oklahoma	Logan	40083	10.03	7.28	12.31	7.31	-0.60	16.34
Oklahoma	Love	40085	6.51	4.74	9.18	3.37	-3.04	12.03
Oklahoma	McClain	40087	10.88	8.38	14.15	3.27	-5.59	11.34

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State	**County**	**FIPS**	**rate**	**95% CI**		**AAPC**	**95% CI**	
Oklahoma	McCurtain	40089	7.14	5.41	9.53	-1.04	-7.36	6.19
Oklahoma	McIntosh	40091	14.53	9.77	18.62	3.30	-4.93	11.48
Oklahoma	Major	40093	4.72	3.29	7.66	3.92	-7.42	10.37
Oklahoma	Marshall	40095	*	*	*	*	*	*
Oklahoma	Mayes	40097	9.37	7.42	12.39	-0.03	-8.45	10.35
Oklahoma	Murray	40099	*	*	*	*	*	*
Oklahoma	Muskogee	40101	13.41	10.77	17.91	4.98	-4.25	14.61
Oklahoma	Noble	40103	8.00	5.67	10.25	4.65	-3.13	12.75
Oklahoma	Nowata	40105	6.03	4.92	7.70	1.99	-6.11	10.12
Oklahoma	Okfuskee	40107	12.50	10.65	14.77	5.97	-0.23	12.98
Oklahoma	Oklahoma	40109	14.38	12.57	16.83	2.73	-2.21	7.65
Oklahoma	Okmulgee	40111	13.92	9.80	18.56	5.58	-2.16	14.84
Oklahoma	Osage	40113	9.56	7.78	12.18	2.72	-2.65	9.03
Oklahoma	Ottawa	40115	5.55	4.32	8.78	-6.77	-16.02	3.19
Oklahoma	Pawnee	40117	10.19	7.65	12.98	3.23	-3.75	10.17
Oklahoma	Payne	40119	8.99	6.90	11.60	4.85	-3.01	11.87
Oklahoma	Pittsburg	40121	13.81	9.97	20.55	4.83	-4.07	14.36
Oklahoma	Pontotoc	40123	12.26	8.41	16.40	2.40	-3.35	7.75
Oklahoma	Pottawatomie	40125	11.72	8.96	15.56	2.32	-4.53	11.14
Oklahoma	Pushmataha	40127	7.77	5.34	10.29	2.15	-4.60	11.51
Oklahoma	Roger Mills	40129	*	*	*	*	*	*
Oklahoma	Rogers	40131	9.01	6.79	11.69	7.38	-2.18	16.17
Oklahoma	Seminole	40133	*	*	*	*	*	*
Oklahoma	Sequoyah	40135	7.76	5.83	10.93	1.14	-5.08	9.30
Oklahoma	Stephens	40137	9.51	7.22	12.33	2.94	-6.40	9.98
Oklahoma	Texas	40139	3.87	2.87	5.04	-5.99	-13.49	2.68
Oklahoma	Tillman	40141	8.00	5.51	10.81	0.22	-7.45	9.62
Oklahoma	Tulsa	40143	12.32	10.56	14.24	6.48	1.89	11.33
Oklahoma	Wagoner	40145	8.55	5.67	11.35	6.82	-2.55	14.70
Oklahoma	Washington	40147	7.24	5.66	10.09	4.45	-3.23	14.16
Oklahoma	Washita	40149	6.62	4.53	9.79	-1.75	-9.55	11.01
Oklahoma	Woods	40151	4.05	2.99	6.03	-0.48	-7.00	6.75
Oklahoma	Woodward	40153	6.49	4.66	8.84	-1.44	-9.48	10.22
Oregon	Baker	41001	*	*	*	*	*	*
Oregon	Benton	41003	6.54	4.85	8.63	-0.22	-8.69	7.50
Oregon	Clackamas	41005	6.77	5.51	8.07	0.98	-5.69	7.26
Oregon	Clatsop	41007	9.21	6.20	13.36	-5.72	-14.28	3.01
Oregon	Columbia	41009	7.65	6.01	9.50	-4.54	-11.49	3.21
Oregon	Coos	41011	14.78	10.98	22.88	-2.14	-12.96	9.07
Oregon	Crook	41013	6.18	3.70	8.24	-8.07	-15.96	3.74

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State	**County**	**FIPS**	**rate**	**95% CI**		**AAPC**	**95% CI**	
Oregon	Curry	41015	14.41	9.98	23.15	0.49	-7.43	12.14
Oregon	Deschutes	41017	6.90	5.61	8.87	-6.10	-11.46	1.01
Oregon	Douglas	41019	12.01	9.53	15.52	-8.22	-14.61	0.15
Oregon	Gilliam	41021	6.26	4.12	9.58	-0.89	-8.58	8.24
Oregon	Grant	41023	4.89	3.73	6.86	-7.76	-14.80	0.42
Oregon	Harney	41025	5.67	3.86	7.01	-6.71	-14.79	0.52
Oregon	Hood River	41027	7.44	4.81	10.60	0.74	-8.85	9.93
Oregon	Jackson	41029	9.47	7.18	12.75	-7.75	-13.74	1.60
Oregon	Jefferson	41031	8.51	6.63	12.45	-4.14	-10.43	5.08
Oregon	Josephine	41033	12.02	9.26	15.41	-7.77	-15.04	-0.90
Oregon	Klamath	41035	11.15	8.60	14.17	-5.68	-12.37	1.08
Oregon	Lake	41037	*	*	*	*	*	*
Oregon	Lane	41039	12.65	10.90	14.73	-4.40	-8.50	0.55
Oregon	Lincoln	41041	12.86	9.91	17.28	-5.46	-13.61	2.47
Oregon	Linn	41043	14.21	10.77	17.57	-0.36	-8.35	7.82
Oregon	Malheur	41045	8.02	5.93	10.57	-7.50	-14.99	0.21
Oregon	Marion	41047	10.74	8.84	12.81	-0.41	-6.67	4.74
Oregon	Morrow	41049	5.20	4.13	6.74	-5.47	-12.90	2.38
Oregon	Multnomah	41051	12.41	10.75	14.21	-2.25	-6.62	2.85
Oregon	Polk	41053	8.54	6.14	10.76	-1.71	-10.21	5.22
Oregon	Sherman	41055	*	*	*	*	*	*
Oregon	Tillamook	41057	8.61	6.59	11.33	-2.20	-9.43	5.38
Oregon	Umatilla	41059	6.24	4.93	8.20	-8.93	-16.05	-2.31
Oregon	Union	41061	4.35	2.68	5.75	-11.83	-21.24	-1.52
Oregon	Wallowa	41063	4.11	3.17	5.33	-8.33	-13.98	-1.92
Oregon	Wasco	41065	10.52	7.54	13.62	-1.08	-9.35	5.96
Oregon	Washington	41067	4.72	3.86	5.73	-4.02	-8.88	1.91
Oregon	Wheeler	41069	6.50	4.92	10.17	-4.65	-12.16	5.17
Oregon	Yamhill	41071	7.26	5.41	9.86	1.66	-5.37	10.86
Pennsylvania	Adams	42001	2.22	1.71	3.26	0.80	-7.87	11.95
Pennsylvania	Allegheny	42003	3.31	2.75	3.88	-3.54	-8.69	1.88
Pennsylvania	Armstrong	42005	1.68	1.26	2.20	2.30	-5.68	10.05
Pennsylvania	Beaver	42007	2.48	1.88	3.37	-0.67	-8.43	9.25
Pennsylvania	Bedford	42009	2.01	1.45	2.65	-1.09	-8.40	8.08
Pennsylvania	Berks	42011	3.55	2.84	4.34	-8.02	-13.39	-3.06
Pennsylvania	Blair	42013	2.06	1.46	2.62	-1.64	-8.96	5.73
Pennsylvania	Bradford	42015	3.58	2.53	5.59	-0.13	-6.91	9.48
Pennsylvania	Bucks	42017	2.43	2.06	2.87	-7.10	-11.18	-1.80
Pennsylvania	Butler	42019	1.73	1.32	2.21	1.11	-5.29	9.15
Pennsylvania	Cambria	42021	2.10	1.68	2.64	-2.70	-8.38	2.93

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State	**County**	**FIPS**	**rate**	**95% CI**		**AAPC**	**95% CI**	
Pennsylvania	Cameron	42023	*	*	*	*	*	*
Pennsylvania	Carbon	42025	3.56	2.83	5.95	-3.88	-11.49	7.82
Pennsylvania	Centre	42027	1.89	1.52	2.46	-2.33	-9.53	5.75
Pennsylvania	Chester	42029	2.45	1.93	3.06	-5.32	-10.40	1.78
Pennsylvania	Clarion	42031	1.68	1.26	2.58	0.76	-6.03	9.47
Pennsylvania	Clearfield	42033	1.98	1.51	2.66	0.91	-6.83	9.88
Pennsylvania	Clinton	42035	2.91	1.84	4.09	-0.17	-7.87	9.45
Pennsylvania	Columbia	42037	*	*	*	*	*	*
Pennsylvania	Crawford	42039	1.92	1.39	3.07	1.41	-7.92	10.84
Pennsylvania	Cumberland	42041	2.12	1.61	2.72	-2.03	-9.11	5.74
Pennsylvania	Dauphin	42043	3.85	2.92	5.26	-2.44	-7.85	3.15
Pennsylvania	Delaware	42045	3.20	2.49	3.82	-9.55	-14.72	-4.34
Pennsylvania	Elk	42047	2.05	1.50	2.91	3.31	-5.07	13.71
Pennsylvania	Erie	42049	2.50	1.90	3.17	-4.12	-11.24	3.12
Pennsylvania	Fayette	42051	3.46	2.48	4.80	1.83	-5.48	8.54
Pennsylvania	Forest	42053	1.94	1.49	2.67	-2.04	-8.96	4.94
Pennsylvania	Franklin	42055	2.75	2.09	3.72	-2.35	-8.46	3.79
Pennsylvania	Fulton	42057	2.84	2.01	3.95	-2.17	-11.54	7.49
Pennsylvania	Greene	42059	3.19	2.41	4.41	-0.30	-8.81	10.73
Pennsylvania	Huntingdon	42061	2.25	1.72	2.97	-3.60	-10.14	2.57
Pennsylvania	Indiana	42063	1.72	1.32	2.62	0.97	-7.28	9.44
Pennsylvania	Jefferson	42065	1.77	1.31	2.79	3.59	-5.24	18.84
Pennsylvania	Juniata	42067	1.61	1.15	2.17	-0.37	-7.50	6.99
Pennsylvania	Lackawanna	42069	3.39	2.45	4.50	-3.16	-10.34	3.41
Pennsylvania	Lancaster	42071	3.03	2.43	3.79	-6.39	-11.12	-0.59
Pennsylvania	Lawrence	42073	2.30	1.49	3.17	0.16	-8.83	14.25
Pennsylvania	Lebanon	42075	2.92	1.95	3.98	-6.37	-13.58	0.04
Pennsylvania	Lehigh	42077	3.46	2.66	4.17	-8.84	-14.93	-3.59
Pennsylvania	Luzerne	42079	3.65	2.98	5.03	-4.27	-10.27	1.82
Pennsylvania	Lycoming	42081	3.84	2.93	5.92	-4.14	-10.10	3.09
Pennsylvania	McKean	42083	1.95	1.35	2.55	-0.66	-9.03	7.18
Pennsylvania	Mercer	42085	2.13	1.57	2.64	-0.86	-7.62	5.81
Pennsylvania	Mifflin	42087	1.61	1.23	2.78	-3.83	-10.16	2.28
Pennsylvania	Monroe	42089	4.63	3.54	5.80	-4.12	-10.61	2.66
Pennsylvania	Montgomery	42091	2.58	2.09	3.17	-7.53	-12.53	-2.01
Pennsylvania	Montour	42093	*	*	*	*	*	*
Pennsylvania	Northampton	42095	3.82	3.01	4.99	3.28	-5.53	11.63
Pennsylvania	Northumberland	42097	2.37	1.72	3.13	-1.76	-8.93	4.42
Pennsylvania	Perry	42099	1.98	1.41	2.70	-2.96	-10.11	3.59
Pennsylvania	Philadelphia	42101	6.67	5.93	7.58	-8.27	-11.53	-4.56

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			2017 Rate per 100,000			2013-2017 AAPC		
State	**County**	**FIPS**	**rate**	**95% CI**		**AAPC**	**95% CI**	
Pennsylvania	Pike	42103	2.67	2.14	3.41	-5.25	-12.57	3.75
Pennsylvania	Potter	42105	2.01	1.46	2.86	-0.82	-7.92	6.20
Pennsylvania	Schuylkill	42107	3.64	2.58	5.11	-3.27	-10.45	3.44
Pennsylvania	Snyder	42109	*	*	*	*	*	*
Pennsylvania	Somerset	42111	2.08	1.67	2.59	2.55	-4.52	11.99
Pennsylvania	Sullivan	42113	3.95	2.99	5.59	-3.44	-9.72	3.84
Pennsylvania	Susquehanna	42115	4.02	3.00	5.04	-0.61	-9.17	6.84
Pennsylvania	Tioga	42117	2.44	1.62	3.56	-2.26	-10.66	7.91
Pennsylvania	Union	42119	2.23	1.64	2.85	-2.58	-9.36	2.94
Pennsylvania	Venango	42121	2.32	1.48	3.54	1.42	-7.64	7.44
Pennsylvania	Warren	42123	1.74	1.37	2.21	1.54	-5.27	8.29
Pennsylvania	Washington	42125	3.14	2.56	3.84	-0.44	-5.94	5.47
Pennsylvania	Wayne	42127	4.20	3.18	5.96	-4.69	-11.57	2.40
Pennsylvania	Westmoreland	42129	2.55	1.94	3.14	1.69	-4.57	8.08
Pennsylvania	Wyoming	42131	3.63	2.45	5.33	-2.49	-10.97	6.33
Pennsylvania	York	42133	3.01	2.40	3.67	-2.96	-9.10	4.17
Rhode Island	Bristol	44001	*	*	*	*	*	*
Rhode Island	Kent	44003	4.04	3.17	5.22	-8.87	-16.24	-0.53
Rhode Island	Newport	44005	4.37	2.92	6.86	-1.22	-10.06	14.05
Rhode Island	Providence	44007	6.81	5.90	8.04	-3.33	-8.64	2.85
Rhode Island	Washington	44009	2.98	2.17	4.22	-5.42	-16.01	7.55
South Carolina	Abbeville	45001	4.22	3.40	5.66	-2.47	-7.77	3.21
South Carolina	Aiken	45003	3.39	2.76	4.37	-3.16	-8.52	3.44
South Carolina	Allendale	45005	4.28	3.44	5.66	-2.88	-9.11	2.92
South Carolina	Anderson	45007	7.04	5.88	8.37	-1.87	-7.51	3.75
South Carolina	Bamberg	45009	3.56	2.74	4.69	-2.66	-8.50	2.92
South Carolina	Barnwell	45011	3.80	2.13	5.45	-2.33	-9.11	4.54
South Carolina	Beaufort	45013	3.00	2.27	4.03	-0.84	-9.18	9.90
South Carolina	Berkeley	45015	3.60	2.71	4.77	0.09	-6.75	7.33
South Carolina	Calhoun	45017	2.99	2.18	4.18	-2.75	-8.60	4.14
South Carolina	Charleston	45019	5.59	4.44	7.08	-3.22	-9.59	2.47
South Carolina	Cherokee	45021	4.58	3.32	5.94	-1.17	-8.83	8.44
South Carolina	Chester	45023	4.18	3.03	5.60	-2.51	-9.93	6.38
South Carolina	Chesterfield	45025	3.90	2.95	4.72	-3.37	-10.92	2.86
South Carolina	Clarendon	45027	3.60	2.77	4.98	-2.65	-9.67	5.20
South Carolina	Colleton	45029	5.25	4.14	6.76	-1.28	-7.13	4.60
South Carolina	Darlington	45031	2.91	2.27	4.54	-2.75	-8.81	3.90
South Carolina	Dillon	45033	3.32	2.41	4.61	-2.49	-9.71	7.13
South Carolina	Dorchester	45035	4.20	3.30	5.22	-2.81	-9.12	6.04
South Carolina	Edgefield	45037	3.25	2.37	4.51	-2.75	-8.02	3.27

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State	County	FIPS	2017 Rate per 100,000 rate	95% CI		2013-2017 AAPC AAPC	95% CI	
South Carolina	Fairfield	45039	3.51	2.57	4.39	-2.83	-9.66	4.95
South Carolina	Florence	45041	3.55	2.89	5.45	-2.68	-8.11	3.34
South Carolina	Georgetown	45043	3.84	2.83	5.34	-0.72	-10.40	7.78
South Carolina	Greenville	45045	5.45	4.68	6.43	-1.26	-5.97	3.47
South Carolina	Greenwood	45047	4.90	3.68	6.46	-2.57	-8.06	2.79
South Carolina	Hampton	45049	3.32	2.59	4.26	-2.20	-7.87	3.85
South Carolina	Horry	45051	4.56	3.55	5.81	-3.21	-9.87	3.48
South Carolina	Jasper	45053	3.41	2.39	5.60	-2.43	-11.94	8.30
South Carolina	Kershaw	45055	4.68	3.73	6.39	-2.51	-8.95	4.74
South Carolina	Lancaster	45057	4.04	3.28	5.24	-3.45	-9.53	4.58
South Carolina	Laurens	45059	7.08	5.73	8.94	-2.37	-7.78	3.56
South Carolina	Lee	45061	3.47	2.70	4.38	-2.98	-8.88	3.89
South Carolina	Lexington	45063	3.08	2.48	4.01	-2.55	-7.55	5.52
South Carolina	McCormick	45065	3.48	2.58	5.09	-1.53	-8.25	4.63
South Carolina	Marion	45067	2.62	1.96	3.64	-1.33	-8.67	5.63
South Carolina	Marlboro	45069	3.85	2.90	5.07	-3.00	-8.66	3.43
South Carolina	Newberry	45071	3.51	2.87	4.60	-3.10	-9.30	2.78
South Carolina	Oconee	45073	4.19	3.18	5.33	-1.41	-7.19	6.47
South Carolina	Orangeburg	45075	3.36	2.83	4.15	-2.76	-7.33	2.17
South Carolina	Pickens	45077	4.79	3.31	6.03	-3.14	-12.01	5.29
South Carolina	Richland	45079	5.62	4.64	6.65	-2.93	-8.42	3.35
South Carolina	Saluda	45081	2.96	2.23	4.08	-4.13	-11.08	2.47
South Carolina	Spartanburg	45083	6.56	5.42	7.92	2.63	-3.83	8.98
South Carolina	Sumter	45085	3.54	2.65	4.46	-2.39	-8.72	3.47
South Carolina	Union	45087	4.85	3.37	6.05	-2.20	-9.73	4.40
South Carolina	Williamsburg	45089	2.87	1.85	4.19	-0.89	-9.40	7.63
South Carolina	York	45091	4.09	3.19	5.43	-2.79	-8.39	5.72
South Dakota	Aurora	46003	2.65	1.64	4.01	-2.92	-9.11	5.69
South Dakota	Beadle	46005	2.48	1.73	3.70	-4.85	-11.17	3.06
South Dakota	Bennett	46007	3.21	2.49	4.41	2.14	-5.71	11.04
South Dakota	Bon Homme	46009	*	*	*	*	*	*
South Dakota	Brookings	46011	2.12	1.70	2.69	-3.50	-9.97	2.81
South Dakota	Brown	46013	2.55	1.78	3.32	-3.98	-12.28	4.09
South Dakota	Brule	46015	2.69	1.99	3.58	-1.49	-8.43	5.35
South Dakota	Buffalo	46017	4.07	2.79	6.10	-2.79	-9.39	5.12
South Dakota	Butte	46019	3.29	2.54	4.25	-5.68	-13.07	3.95
South Dakota	Campbell	46021	2.95	2.10	4.39	-5.08	-12.56	3.36
South Dakota	Charles Mix	46023	2.96	1.81	3.72	-2.50	-10.33	4.17
South Dakota	Clark	46025	2.12	1.64	2.77	-4.46	-12.47	5.35
South Dakota	Clay	46027	*	*	*	*	*	*

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			2017 Rate per 100,000			2013-2017 AAPC		
State	**County**	**FIPS**	**rate**	**95% CI**		**AAPC**	**95% CI**	
South Dakota	Codington	46029	1.97	1.48	2.82	-4.55	-11.79	3.92
South Dakota	Corson	46031	3.72	2.95	5.51	-1.62	-8.08	5.01
South Dakota	Custer	46033	3.93	2.58	5.17	1.06	-7.79	11.96
South Dakota	Davison	46035	2.22	1.42	3.29	-2.05	-10.96	6.18
South Dakota	Day	46037	2.88	2.29	3.65	-7.15	-14.28	-0.80
South Dakota	Deuel	46039	2.94	2.19	4.39	-6.77	-13.88	0.70
South Dakota	Dewey	46041	4.11	3.11	5.14	-0.61	-7.82	6.45
South Dakota	Douglas	46043	2.09	1.44	3.26	-3.22	-11.21	5.63
South Dakota	Edmunds	46045	2.37	1.74	4.03	-2.47	-10.55	7.67
South Dakota	Fall River	46047	6.31	4.52	9.17	1.30	-7.51	10.66
South Dakota	Faulk	46049	2.67	1.80	4.23	-1.17	-10.42	10.64
South Dakota	Grant	46051	2.17	1.49	3.19	-5.76	-13.15	3.49
South Dakota	Gregory	46053	2.92	1.86	4.28	-2.89	-9.20	4.86
South Dakota	Haakon	46055	4.22	3.18	5.45	-3.35	-11.86	4.23
South Dakota	Hamlin	46057	2.20	1.41	3.13	-4.35	-12.82	7.08
South Dakota	Hand	46059	2.75	2.14	3.64	-5.43	-14.50	3.62
South Dakota	Hanson	46061	3.23	1.78	4.99	-4.07	-11.12	5.40
South Dakota	Harding	46063	2.85	2.28	3.65	-4.51	-12.60	2.31
South Dakota	Hughes	46065	2.60	1.62	3.60	-2.77	-14.41	6.99
South Dakota	Hutchinson	46067	2.55	1.92	3.25	-2.59	-8.42	2.83
South Dakota	Hyde	46069	2.62	1.91	3.62	-1.42	-10.76	7.00
South Dakota	Jackson	46071	2.97	2.03	4.86	-0.89	-8.21	5.33
South Dakota	Jerauld	46073	2.72	1.94	3.76	-2.84	-9.83	5.35
South Dakota	Jones	46075	3.14	2.09	4.23	-3.99	-12.05	6.04
South Dakota	Kingsbury	46077	1.95	1.33	2.76	-1.52	-10.73	5.83
South Dakota	Lake	46079	*	*	*	*	*	*
South Dakota	Lawrence	46081	2.38	1.60	3.43	-0.98	-10.34	7.48
South Dakota	Lincoln	46083	1.91	1.44	2.70	-5.04	-14.23	4.50
South Dakota	Lyman	46085	3.10	2.51	3.87	-2.97	-7.75	2.47
South Dakota	McCook	46087	1.99	1.42	2.65	-2.28	-9.30	6.39
South Dakota	McPherson	46089	2.65	2.04	3.51	-5.08	-14.19	4.29
South Dakota	Marshall	46091	2.55	1.64	3.21	-6.35	-13.41	0.59
South Dakota	Meade	46093	3.19	2.35	4.77	-2.26	-11.30	5.14
South Dakota	Mellette	46095	3.32	2.47	4.16	-1.20	-7.21	4.68
South Dakota	Miner	46097	2.30	1.63	3.79	-1.75	-8.34	6.30
South Dakota	Minnehaha	46099	2.92	2.36	3.64	-5.30	-11.29	3.04
South Dakota	Moody	46101	2.25	1.71	2.82	-3.93	-9.98	4.72
South Dakota	Shannon	46102	5.02	3.69	6.69	-0.07	-6.52	8.18
South Dakota	Pennington	46103	3.61	2.56	4.82	0.85	-7.97	7.70
South Dakota	Perkins	46105	3.19	2.33	4.49	-4.10	-12.36	5.49

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State	**County**	**FIPS**	**rate**	**95% CI**		**AAPC**	**95% CI**	
South Dakota	Potter	46107	3.27	2.11	4.70	0.55	-9.18	11.40
South Dakota	Roberts	46109	2.48	1.93	3.38	-6.37	-12.95	0.83
South Dakota	Sanborn	46111	2.49	1.32	3.78	-2.90	-12.61	5.07
South Dakota	Spink	46115	2.29	1.84	3.00	-5.43	-11.37	0.64
South Dakota	Stanley	46117	3.06	2.03	4.33	-4.64	-11.29	2.34
South Dakota	Sully	46119	*	*	*	*	*	*
South Dakota	Todd	46121	3.50	2.73	5.29	0.08	-5.92	6.34
South Dakota	Tripp	46123	2.75	1.73	3.56	-3.40	-11.31	3.90
South Dakota	Turner	46125	2.54	1.71	3.83	-3.63	-12.99	4.71
South Dakota	Union	46127	2.17	1.57	2.87	-6.41	-14.38	-0.09
South Dakota	Walworth	46129	3.06	2.07	4.22	-1.48	-11.43	8.75
South Dakota	Yankton	46135	2.65	1.95	3.41	-2.71	-9.48	4.16
South Dakota	Ziebach	46137	4.11	3.12	5.02	-1.15	-6.65	4.54
Tennessee	Anderson	47001	7.48	5.08	10.74	3.28	-6.50	13.65
Tennessee	Bedford	47003	7.61	5.82	10.28	-0.53	-9.88	6.97
Tennessee	Benton	47005	6.56	4.52	8.30	-11.02	-19.53	-2.99
Tennessee	Bledsoe	47007	5.34	3.86	7.13	-1.70	-10.14	10.42
Tennessee	Blount	47009	6.54	4.79	8.33	-4.11	-10.76	2.18
Tennessee	Bradley	47011	4.27	2.82	5.80	-4.23	-15.95	1.84
Tennessee	Campbell	47013	10.24	8.00	14.51	3.90	-4.92	15.41
Tennessee	Cannon	47015	*	*	*	*	*	*
Tennessee	Carroll	47017	4.74	3.69	6.31	-11.43	-19.88	-4.46
Tennessee	Carter	47019	6.67	4.43	8.80	-4.31	-11.85	4.28
Tennessee	Cheatham	47021	5.76	3.96	7.78	-7.29	-14.66	0.02
Tennessee	Chester	47023	5.95	4.27	8.31	-8.68	-17.12	-1.88
Tennessee	Claiborne	47025	7.80	5.09	11.05	6.29	-1.57	16.59
Tennessee	Clay	47027	4.87	3.60	6.51	-3.57	-11.63	6.13
Tennessee	Cocke	47029	7.43	5.38	9.73	-3.37	-12.07	4.39
Tennessee	Coffee	47031	6.10	4.57	8.64	-3.22	-10.96	5.24
Tennessee	Crockett	47033	4.89	3.54	7.30	-5.46	-14.39	1.36
Tennessee	Cumberland	47035	5.67	4.18	7.48	-3.71	-11.47	3.99
Tennessee	Davidson	47037	7.95	6.62	9.31	-6.22	-11.26	-2.39
Tennessee	Decatur	47039	4.05	2.81	5.26	-8.65	-16.50	-0.79
Tennessee	DeKalb	47041	6.54	4.87	9.56	-2.28	-10.82	9.89
Tennessee	Dickson	47043	4.67	3.55	6.10	-7.93	-15.57	-0.92
Tennessee	Dyer	47045	3.74	2.79	5.06	-6.20	-14.98	1.83
Tennessee	Fayette	47047	4.37	3.16	6.16	-7.40	-12.95	-1.15
Tennessee	Fentress	47049	6.78	4.93	10.20	-5.53	-12.15	2.13
Tennessee	Franklin	47051	4.27	3.22	5.34	-1.84	-7.53	3.60
Tennessee	Gibson	47053	4.58	3.49	5.87	-8.92	-15.20	-2.34

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Tennessee	Giles	47055	3.95	3.14	5.86	-3.09	-9.33	8.56
Tennessee	Grainger	47057	6.39	4.75	8.37	1.55	-6.12	9.05
Tennessee	Greene	47059	4.77	3.35	6.65	-3.38	-12.25	5.87
Tennessee	Grundy	47061	*	*	*	*	*	*
Tennessee	Hamblen	47063	6.20	4.75	8.18	-2.81	-10.14	5.24
Tennessee	Hamilton	47065	6.37	5.35	7.58	-0.07	-5.52	5.15
Tennessee	Hancock	47067	4.93	3.46	6.73	1.95	-6.01	13.77
Tennessee	Hardeman	47069	5.22	4.21	6.74	-6.86	-11.20	-1.79
Tennessee	Hardin	47071	5.56	4.47	6.93	-6.21	-12.37	0.33
Tennessee	Hawkins	47073	5.39	4.33	6.79	-1.97	-8.75	4.86
Tennessee	Haywood	47075	4.50	3.47	6.54	-3.98	-11.44	3.63
Tennessee	Henderson	47077	6.48	4.48	8.84	-9.75	-15.83	-0.35
Tennessee	Henry	47079	5.39	4.18	6.86	-11.74	-17.68	-3.28
Tennessee	Hickman	47081	4.83	3.41	6.47	-6.42	-12.96	2.63
Tennessee	Houston	47083	4.01	3.02	5.14	-4.76	-13.48	3.04
Tennessee	Humphreys	47085	5.40	4.02	6.83	-9.13	-14.00	-3.64
Tennessee	Jackson	47087	7.56	5.26	10.83	-7.02	-14.22	0.16
Tennessee	Jefferson	47089	7.80	5.78	10.74	1.13	-6.74	8.77
Tennessee	Johnson	47091	5.82	4.32	8.32	-4.49	-14.31	2.92
Tennessee	Knox	47093	6.57	5.61	8.07	-0.70	-7.00	5.08
Tennessee	Lake	47095	5.76	3.70	7.47	-7.18	-14.74	-0.05
Tennessee	Lauderdale	47097	4.18	3.12	5.67	-5.73	-13.30	2.47
Tennessee	Lawrence	47099	4.37	3.16	5.71	-7.45	-14.88	1.45
Tennessee	Lewis	47101	3.72	2.73	5.37	-7.81	-15.62	-1.58
Tennessee	Lincoln	47103	3.84	3.24	5.23	-0.32	-7.13	7.94
Tennessee	Loudon	47105	4.45	3.16	6.38	-0.05	-6.77	8.22
Tennessee	McMinn	47107	5.52	3.71	7.89	-2.97	-11.53	4.81
Tennessee	McNairy	47109	6.94	4.76	9.41	-8.51	-17.05	-1.72
Tennessee	Macon	47111	3.67	2.30	5.03	-4.63	-12.21	7.12
Tennessee	Madison	47113	5.38	4.12	6.80	-8.62	-13.92	-2.69
Tennessee	Marion	47115	5.84	4.31	7.19	-0.31	-6.54	5.53
Tennessee	Marshall	47117	4.11	2.75	5.88	-2.74	-7.95	3.08
Tennessee	Maury	47119	3.98	3.06	5.22	-4.49	-12.69	3.01
Tennessee	Meigs	47121	*	*	*	*	*	*
Tennessee	Monroe	47123	6.43	4.51	8.59	-1.05	-10.34	7.60
Tennessee	Montgomery	47125	5.23	3.91	6.68	-5.00	-11.41	1.62
Tennessee	Moore	47127	*	*	*	*	*	*
Tennessee	Morgan	47129	5.73	3.83	8.10	-0.07	-9.71	9.73
Tennessee	Obion	47131	3.72	2.82	5.22	-10.23	-16.90	-2.67
Tennessee	Overton	47133	6.39	4.36	9.40	-4.66	-12.41	5.75

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			2017 Rate per 100,000			2013-2017 AAPC		
State	**County**	**FIPS**	**rate**	**95% CI**		**AAPC**	**95% CI**	
Tennessee	Perry	47135	5.32	3.76	7.08	-9.31	-15.32	-2.58
Tennessee	Pickett	47137	4.70	3.11	6.43	2.88	-5.89	11.00
Tennessee	Polk	47139	3.83	2.99	5.28	-3.65	-11.78	3.57
Tennessee	Putnam	47141	5.21	4.06	6.87	-5.56	-14.32	1.54
Tennessee	Rhea	47143	5.08	3.74	7.50	-2.20	-12.51	9.24
Tennessee	Roane	47145	6.27	5.15	8.08	-3.14	-10.13	4.91
Tennessee	Robertson	47147	4.31	3.09	5.88	-7.81	-14.39	0.53
Tennessee	Rutherford	47149	4.88	3.46	5.97	-4.88	-11.51	0.54
Tennessee	Scott	47151	5.32	3.23	7.35	3.85	-4.22	13.28
Tennessee	Sequatchie	47153	5.57	4.41	7.38	0.01	-7.12	9.61
Tennessee	Sevier	47155	7.49	5.04	9.80	-0.50	-8.91	6.32
Tennessee	Shelby	47157	6.28	5.47	7.31	-3.63	-8.67	0.72
Tennessee	Smith	47159	5.51	3.56	7.96	-2.86	-10.86	12.62
Tennessee	Stewart	47161	4.91	3.63	6.63	-7.39	-15.02	0.72
Tennessee	Sullivan	47163	5.38	4.11	6.77	-5.70	-12.01	0.83
Tennessee	Sumner	47165	4.58	3.69	6.90	-7.43	-13.63	3.56
Tennessee	Tipton	47167	4.54	3.54	5.83	-6.48	-13.92	0.39
Tennessee	Trousdale	47169	4.07	2.89	6.02	-4.88	-14.72	12.42
Tennessee	Unicoi	47171	5.02	3.74	7.56	-0.19	-6.76	7.15
Tennessee	Union	47173	9.18	6.18	12.74	3.31	-8.00	13.33
Tennessee	Van Buren	47175	5.51	4.00	7.96	-1.94	-10.70	6.96
Tennessee	Warren	47177	7.03	5.07	9.04	-1.80	-8.28	7.27
Tennessee	Washington	47179	5.27	3.97	7.01	-5.56	-12.03	1.19
Tennessee	Wayne	47181	3.82	2.93	4.92	-8.74	-15.43	-1.08
Tennessee	Weakley	47183	3.21	2.29	4.30	-10.61	-16.49	-0.87
Tennessee	White	47185	6.19	4.39	9.23	-5.82	-13.53	4.27
Tennessee	Williamson	47187	2.40	1.75	3.11	-4.28	-11.74	2.10
Tennessee	Wilson	47189	4.16	3.08	5.94	-3.80	-13.49	6.95
Texas	Anderson	48001	22.92	17.75	30.50	11.47	2.45	21.38
Texas	Andrews	48003	5.62	4.14	8.52	-0.75	-10.90	11.82
Texas	Angelina	48005	7.63	6.08	9.38	1.10	-4.91	7.99
Texas	Aransas	48007	18.40	11.70	29.76	5.80	-4.94	16.69
Texas	Archer	48009	8.75	6.36	12.18	2.40	-6.17	9.88
Texas	Armstrong	48011	6.73	4.97	10.01	-0.39	-7.44	9.19
Texas	Atascosa	48013	7.27	5.94	9.13	-0.37	-5.80	6.91
Texas	Austin	48015	4.28	3.13	6.49	-3.14	-9.98	4.96
Texas	Bailey	48017	4.87	3.84	6.61	1.54	-7.05	10.02
Texas	Bandera	48019	6.89	5.08	9.29	-2.27	-9.74	6.62
Texas	Bastrop	48021	6.01	4.57	7.77	-8.89	-14.73	-2.78
Texas	Baylor	48023	8.13	6.27	10.59	0.72	-6.66	8.70

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			2017 Rate per 100,000			2013-2017 AAPC		
State	**County**	**FIPS**	**rate**	**95% CI**		**AAPC**	**95% CI**	
Texas	Bee	48025	10.98	8.41	14.61	-0.12	-8.67	8.17
Texas	Bell	48027	7.98	6.40	9.66	-1.22	-7.89	4.04
Texas	Bexar	48029	8.64	7.65	9.72	-3.35	-6.47	0.78
Texas	Blanco	48031	4.55	3.23	6.13	-6.07	-13.04	1.51
Texas	Borden	48033	5.81	4.31	7.98	-0.01	-7.51	10.34
Texas	Bosque	48035	6.96	4.91	10.80	1.56	-5.58	8.98
Texas	Bowie	48037	6.19	4.69	9.10	-2.01	-8.04	6.85
Texas	Brazoria	48039	6.02	4.49	7.77	-3.23	-11.88	3.83
Texas	Brazos	48041	4.57	3.56	5.78	-8.59	-15.63	-3.27
Texas	Brewster	48043	*	*	*	*	*	*
Texas	Briscoe	48045	*	*	*	*	*	*
Texas	Brooks	48047	6.85	5.55	8.78	0.24	-8.63	7.72
Texas	Brown	48049	8.44	6.33	13.36	-0.17	-9.62	9.29
Texas	Burleson	48051	4.21	3.18	6.14	-5.93	-12.13	0.67
Texas	Burnet	48053	6.30	4.76	8.62	-6.45	-14.02	2.34
Texas	Caldwell	48055	6.68	4.92	9.22	-1.93	-8.10	4.55
Texas	Calhoun	48057	8.13	5.02	11.89	-0.33	-9.07	10.98
Texas	Callahan	48059	*	*	*	*	*	*
Texas	Cameron	48061	3.45	2.44	4.62	3.51	-9.16	13.98
Texas	Camp	48063	6.10	4.27	8.98	2.34	-5.92	10.20
Texas	Carson	48065	5.90	3.80	7.97	-1.63	-10.59	4.91
Texas	Cass	48067	8.11	6.16	11.35	0.91	-7.07	9.79
Texas	Castro	48069	*	*	*	*	*	*
Texas	Chambers	48071	6.57	4.55	8.12	-3.69	-11.03	6.16
Texas	Cherokee	48073	7.08	4.83	9.87	4.68	-2.79	11.63
Texas	Childress	48075	6.79	4.63	8.71	0.67	-14.63	9.03
Texas	Clay	48077	7.44	5.07	10.40	0.73	-6.67	8.56
Texas	Cochran	48079	6.14	4.51	10.50	2.23	-7.96	11.01
Texas	Coke	48081	*	*	*	*	*	*
Texas	Coleman	48083	7.62	4.89	11.04	0.50	-8.93	9.51
Texas	Collin	48085	2.40	1.93	2.95	1.46	-3.81	8.10
Texas	Collingsworth	48087	*	*	*	*	*	*
Texas	Colorado	48089	5.69	3.72	7.43	0.08	-9.09	10.41
Texas	Comal	48091	4.89	3.83	7.06	-3.74	-11.99	3.86
Texas	Comanche	48093	*	*	*	*	*	*
Texas	Concho	48095	5.70	3.85	8.45	2.12	-6.19	12.90
Texas	Cooke	48097	5.07	3.58	6.81	2.61	-5.60	10.78
Texas	Coryell	48099	7.63	5.65	10.17	0.32	-7.04	7.85
Texas	Cottle	48101	5.36	3.00	8.16	1.18	-10.40	9.29
Texas	Crane	48103	5.59	3.09	8.47	-1.58	-13.26	10.18

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State	County	FIPS	2017 Rate per 100,000 rate	95% CI		2013-2017 AAPC AAPC	95% CI	
Texas	Crockett	48105	4.00	2.83	5.42	0.20	-9.45	8.29
Texas	Crosby	48107	5.98	4.35	8.67	2.05	-6.79	10.37
Texas	Culberson	48109	5.74	4.05	7.96	-3.36	-15.98	7.16
Texas	Dallam	48111	*	*	*	*	*	*
Texas	Dallas	48113	6.73	6.09	7.49	-0.10	-3.74	3.43
Texas	Dawson	48115	5.84	4.15	8.54	-0.81	-9.38	9.94
Texas	Deaf Smith	48117	*	*	*	*	*	*
Texas	Delta	48119	7.10	5.42	9.01	1.76	-4.51	11.39
Texas	Denton	48121	2.91	2.29	3.72	0.94	-4.77	7.37
Texas	DeWitt	48123	8.47	6.46	10.60	-0.28	-8.13	7.70
Texas	Dickens	48125	5.62	4.11	9.03	1.24	-7.19	12.05
Texas	Dimmit	48127	5.36	3.49	7.89	1.54	-6.18	11.52
Texas	Donley	48129	6.31	4.39	8.41	0.94	-6.69	7.86
Texas	Duval	48131	10.65	7.51	14.43	-0.77	-11.10	8.13
Texas	Eastland	48133	6.17	4.43	8.43	1.80	-4.64	9.15
Texas	Ector	48135	12.19	9.32	16.08	-1.03	-9.04	8.31
Texas	Edwards	48137	4.58	3.71	6.02	1.56	-6.54	10.39
Texas	Ellis	48139	5.78	4.41	7.35	-0.24	-6.85	7.32
Texas	El Paso	48141	7.49	6.01	9.25	3.55	-3.14	9.88
Texas	Erath	48143	5.84	4.50	8.03	-0.13	-6.70	8.26
Texas	Falls	48145	9.14	6.38	12.24	1.89	-6.27	11.23
Texas	Fannin	48147	5.93	4.46	8.92	2.90	-3.32	12.03
Texas	Fayette	48149	4.72	3.73	6.90	-4.07	-10.27	3.33
Texas	Fisher	48151	6.28	4.75	7.87	2.99	-4.61	11.95
Texas	Floyd	48153	6.19	4.68	8.80	1.56	-4.71	11.71
Texas	Foard	48155	4.39	3.08	6.44	1.37	-5.84	10.40
Texas	Fort Bend	48157	2.97	2.51	3.60	-1.86	-6.71	5.29
Texas	Franklin	48159	7.26	5.26	9.87	3.80	-5.35	13.64
Texas	Freestone	48161	8.74	6.70	11.70	6.58	-1.17	13.53
Texas	Frio	48163	7.10	5.55	9.76	0.12	-7.95	9.67
Texas	Gaines	48165	4.98	3.78	6.66	1.79	-6.76	11.81
Texas	Galveston	48167	9.53	7.91	11.70	-3.90	-9.25	2.73
Texas	Garza	48169	6.44	4.43	10.79	0.19	-6.92	9.31
Texas	Gillespie	48171	5.13	3.59	7.18	-4.53	-11.92	3.63
Texas	Glasscock	48173	4.54	3.54	7.17	-0.02	-8.66	12.03
Texas	Goliad	48175	8.72	6.16	11.98	3.79	-4.42	14.43
Texas	Gonzales	48177	5.63	4.53	7.91	-1.62	-7.85	4.99
Texas	Gray	48179	5.87	4.14	7.71	-1.40	-7.94	6.04
Texas	Grayson	48181	6.97	5.31	8.95	3.09	-3.81	10.77
Texas	Gregg	48183	6.56	5.11	8.45	2.65	-4.12	10.06

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State	County	FIPS	2017 Rate per 100,000 rate	95% CI		2013-2017 AAPC AAPC	95% CI	
Texas	Grimes	48185	8.89	6.86	11.38	-8.29	-14.16	-2.24
Texas	Guadalupe	48187	5.89	4.30	7.72	-5.25	-11.95	2.58
Texas	Hale	48189	5.77	4.58	7.43	1.41	-6.18	13.40
Texas	Hall	48191	5.90	4.47	7.96	0.23	-7.27	11.00
Texas	Hamilton	48193	4.92	3.68	7.91	1.20	-7.70	9.32
Texas	Hansford	48195	4.04	3.04	5.88	-5.47	-14.85	4.49
Texas	Hardeman	48197	6.19	3.74	8.13	-0.39	-7.09	7.80
Texas	Hardin	48199	6.81	5.07	8.82	-2.25	-9.80	4.22
Texas	Harris	48201	5.75	5.16	6.43	-2.30	-5.34	1.05
Texas	Harrison	48203	8.33	6.59	10.83	2.66	-5.77	9.46
Texas	Hartley	48205	4.59	3.26	6.66	-5.79	-16.00	4.69
Texas	Haskell	48207	6.74	4.98	9.20	0.64	-7.41	10.12
Texas	Hays	48209	5.88	4.58	7.43	-3.99	-10.94	4.36
Texas	Hemphill	48211	4.68	3.47	6.32	-0.53	-8.27	7.13
Texas	Henderson	48213	9.39	7.45	11.71	3.22	-2.92	10.87
Texas	Hidalgo	48215	2.32	1.79	3.03	-0.40	-10.85	10.04
Texas	Hill	48217	8.90	7.11	11.75	0.82	-6.35	7.87
Texas	Hockley	48219	7.50	5.59	10.65	1.57	-7.84	11.56
Texas	Hood	48221	5.96	4.05	8.43	-2.95	-11.21	4.14
Texas	Hopkins	48223	6.22	4.61	8.83	0.43	-6.81	9.95
Texas	Houston	48225	8.41	6.42	11.27	0.10	-5.08	6.28
Texas	Howard	48227	6.06	4.34	8.19	-0.34	-7.78	10.31
Texas	Hudspeth	48229	4.82	3.43	6.71	0.30	-12.51	9.07
Texas	Hunt	48231	6.02	4.60	8.04	1.66	-5.69	9.28
Texas	Hutchinson	48233	7.19	5.88	9.24	-6.04	-14.17	0.88
Texas	Irion	48235	3.83	2.17	5.63	0.91	-7.96	10.56
Texas	Jack	48237	8.12	5.98	10.59	1.54	-6.50	8.06
Texas	Jackson	48239	*	*	*	*	*	*
Texas	Jasper	48241	7.83	6.06	10.36	2.58	-3.32	9.69
Texas	Jeff Davis	48243	5.50	4.10	7.89	-1.62	-12.30	10.02
Texas	Jefferson	48245	9.43	7.40	11.86	-1.40	-8.53	5.88
Texas	Jim Hogg	48247	6.38	4.11	9.55	-2.03	-9.64	10.34
Texas	Jim Wells	48249	11.74	7.88	16.73	0.81	-9.25	10.06
Texas	Johnson	48251	6.03	4.94	7.69	-0.68	-7.90	6.18
Texas	Jones	48253	*	*	*	*	*	*
Texas	Karnes	48255	10.83	8.48	14.37	-2.71	-9.71	7.75
Texas	Kaufman	48257	5.98	4.55	7.82	1.09	-5.21	7.53
Texas	Kendall	48259	3.53	2.68	5.03	-4.72	-11.51	3.73
Texas	Kenedy	48261	6.33	4.50	8.79	1.54	-7.80	14.75
Texas	Kent	48263	*	*	*	*	*	*

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State	County	FIPS	2017 Rate per 100,000 rate	95% CI		2013-2017 AAPC AAPC	95% CI	
Texas	Kerr	48265	6.85	5.13	9.24	-4.14	-10.83	3.97
Texas	Kimble	48267	4.41	3.37	6.46	-1.01	-8.02	7.23
Texas	King	48269	5.51	4.02	7.32	3.62	-4.67	12.44
Texas	Kinney	48271	4.53	3.29	6.16	1.92	-8.80	10.08
Texas	Kleberg	48273	9.83	7.17	13.33	1.01	-7.90	10.80
Texas	Knox	48275	7.40	5.47	10.04	3.04	-4.36	10.66
Texas	Lamar	48277	7.72	5.94	9.79	2.45	-6.85	8.91
Texas	Lamb	48279	5.44	3.42	7.42	2.05	-8.01	12.77
Texas	Lampasas	48281	5.72	4.23	7.87	-0.58	-8.26	6.82
Texas	La Salle	48283	*	*	*	*	*	*
Texas	Lavaca	48285	5.51	4.29	8.03	1.63	-5.60	7.83
Texas	Lee	48287	4.24	3.35	5.76	-5.18	-11.18	1.25
Texas	Leon	48289	7.94	6.12	11.33	-1.16	-7.75	5.41
Texas	Liberty	48291	7.23	5.71	9.51	-6.48	-12.33	1.47
Texas	Limestone	48293	7.54	5.85	9.61	3.65	-3.07	11.05
Texas	Lipscomb	48295	*	*	*	*	*	*
Texas	Live Oak	48297	8.86	6.03	12.81	-2.03	-9.47	5.53
Texas	Llano	48299	6.33	4.02	8.29	-5.62	-13.28	3.62
Texas	Loving	48301	*	*	*	*	*	*
Texas	Lubbock	48303	9.88	7.84	12.15	4.19	-1.86	10.78
Texas	Lynn	48305	5.05	3.64	8.40	1.58	-7.34	10.65
Texas	McCulloch	48307	5.40	3.30	7.61	-3.13	-10.92	3.95
Texas	McLennan	48309	10.78	8.99	13.02	0.02	-4.75	5.89
Texas	McMullen	48311	7.10	5.08	10.00	1.26	-6.14	12.39
Texas	Madison	48313	8.21	6.05	11.66	-4.28	-10.30	3.56
Texas	Marion	48315	6.98	4.77	9.51	0.97	-6.49	10.35
Texas	Martin	48317	4.69	3.61	5.99	0.98	-9.22	12.80
Texas	Mason	48319	4.54	3.30	5.72	-3.37	-10.82	4.24
Texas	Matagorda	48321	6.73	4.95	9.49	1.77	-6.30	11.88
Texas	Maverick	48323	4.35	3.44	6.38	2.45	-7.17	11.44
Texas	Medina	48325	6.48	4.79	8.48	-1.19	-7.48	8.17
Texas	Menard	48327	4.28	2.86	5.74	-0.76	-9.97	7.80
Texas	Midland	48329	5.41	4.13	6.83	0.42	-9.30	8.74
Texas	Milam	48331	6.13	4.74	7.87	-4.44	-11.31	4.28
Texas	Mills	48333	4.87	3.77	6.38	-0.45	-8.94	10.63
Texas	Mitchell	48335	7.66	5.55	11.06	0.35	-9.26	11.16
Texas	Montague	48337	4.71	3.29	7.17	0.15	-5.73	9.27
Texas	Montgomery	48339	3.51	2.95	4.20	-9.75	-15.24	-4.23
Texas	Moore	48341	5.36	4.30	7.29	-7.76	-15.73	2.79
Texas	Morris	48343	6.42	4.64	8.77	0.69	-5.58	6.23

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State	County	FIPS	2017 Rate per 100,000 rate	95% CI		2013-2017 AAPC AAPC	95% CI	
Texas	Motley	48345	5.49	4.09	8.75	2.65	-5.00	10.92
Texas	Nacogdoches	48347	6.08	4.52	8.43	2.16	-4.99	9.34
Texas	Navarro	48349	7.86	5.96	10.23	6.11	-0.79	15.19
Texas	Newton	48351	6.15	4.98	8.53	2.04	-6.70	8.79
Texas	Nolan	48353	*	*	*	*	*	*
Texas	Nueces	48355	16.66	13.65	19.69	-1.79	-8.17	5.19
Texas	Ochiltree	48357	3.81	2.53	5.37	-4.37	-12.23	4.74
Texas	Oldham	48359	6.20	4.64	8.08	-5.55	-14.67	3.70
Texas	Orange	48361	10.84	7.67	13.70	0.47	-7.02	6.70
Texas	Palo Pinto	48363	6.69	5.09	8.76	1.44	-4.98	8.27
Texas	Panola	48365	7.87	5.92	10.76	1.06	-8.12	10.32
Texas	Parker	48367	5.35	4.09	7.32	-1.87	-9.27	4.51
Texas	Parmer	48369	4.66	3.23	6.30	0.34	-9.33	9.32
Texas	Pecos	48371	5.87	4.34	8.97	-0.55	-11.00	9.23
Texas	Polk	48373	10.07	8.00	13.34	-4.84	-11.11	3.50
Texas	Potter	48375	11.75	8.80	14.70	-6.53	-13.63	-0.26
Texas	Presidio	48377	*	*	*	*	*	*
Texas	Rains	48379	4.56	3.30	6.03	1.09	-9.38	10.59
Texas	Randall	48381	5.26	4.04	7.03	-5.19	-12.15	3.30
Texas	Reagan	48383	3.97	3.04	6.47	0.93	-6.11	11.03
Texas	Real	48385	4.16	2.73	6.40	1.55	-7.57	9.96
Texas	Red River	48387	6.23	4.96	9.11	0.81	-4.60	8.11
Texas	Reeves	48389	5.62	3.97	8.78	-1.13	-11.49	7.53
Texas	Refugio	48391	13.47	9.80	18.63	1.24	-8.57	10.87
Texas	Roberts	48393	5.60	4.01	7.59	-2.38	-11.58	4.62
Texas	Robertson	48395	6.34	5.03	8.27	-2.23	-8.07	4.72
Texas	Rockwall	48397	4.09	2.86	5.65	3.54	-6.04	16.91
Texas	Runnels	48399	7.35	5.41	10.33	0.84	-6.63	10.83
Texas	Rusk	48401	6.90	5.27	9.27	2.14	-6.36	12.15
Texas	Sabine	48403	7.86	6.08	11.06	0.86	-6.81	10.24
Texas	San Augustine	48405	6.89	5.19	10.16	0.69	-7.80	16.82
Texas	San Jacinto	48407	6.75	4.88	8.89	-5.17	-12.55	3.66
Texas	San Patricio	48409	13.45	10.35	17.64	-0.07	-6.54	8.98
Texas	San Saba	48411	5.09	3.85	6.66	-2.91	-9.13	5.58
Texas	Schleicher	48413	4.41	2.91	6.46	1.60	-6.11	12.40
Texas	Scurry	48415	7.10	4.62	10.45	-3.01	-11.87	8.07
Texas	Shackelford	48417	5.29	3.76	7.64	1.04	-7.64	9.95
Texas	Shelby	48419	6.83	5.26	9.43	-0.73	-7.76	8.15
Texas	Sherman	48421	4.53	2.78	6.31	-6.27	-15.21	2.75
Texas	Smith	48423	4.36	3.65	5.60	0.21	-5.77	6.72

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State	County	FIPS	2017 Rate per 100,000 rate	95% CI		2013-2017 AAPC AAPC	95% CI	
Texas	Somervell	48425	*	*	*	*	*	*
Texas	Starr	48427	*	*	*	*	*	*
Texas	Stephens	48429	6.73	4.49	9.17	3.07	-6.53	12.43
Texas	Sterling	48431	5.61	3.50	8.21	2.13	-7.30	10.04
Texas	Stonewall	48433	6.49	5.13	8.80	2.09	-5.60	11.14
Texas	Sutton	48435	*	*	*	*	*	*
Texas	Swisher	48437	6.44	4.04	9.62	1.64	-8.68	11.51
Texas	Tarrant	48439	6.09	5.32	7.03	-1.23	-5.23	2.55
Texas	Taylor	48441	10.92	8.80	13.18	2.73	-3.81	8.90
Texas	Terrell	48443	5.81	3.65	9.12	-1.19	-13.67	8.96
Texas	Terry	48445	6.05	4.44	8.57	1.67	-8.71	10.98
Texas	Throckmorton	48447	6.87	4.83	9.01	3.11	-5.13	10.68
Texas	Titus	48449	5.14	3.80	7.14	1.20	-8.73	9.26
Texas	Tom Green	48451	8.52	6.40	10.43	0.99	-5.73	8.22
Texas	Travis	48453	5.26	4.50	6.18	-8.50	-12.60	-3.63
Texas	Trinity	48455	9.00	6.78	12.24	-1.65	-8.37	7.94
Texas	Tyler	48457	7.25	4.38	11.55	-2.40	-10.06	6.87
Texas	Upshur	48459	6.12	4.81	7.79	1.10	-5.94	8.53
Texas	Upton	48461	5.51	3.83	8.94	-1.34	-11.64	7.64
Texas	Uvalde	48463	5.15	3.83	6.62	0.86	-6.15	8.89
Texas	Val Verde	48465	4.62	2.62	6.32	0.28	-11.07	9.71
Texas	Van Zandt	48467	4.96	3.86	6.31	-0.26	-8.12	7.25
Texas	Victoria	48469	8.93	6.74	11.20	2.76	-4.15	12.51
Texas	Walker	48471	14.54	11.62	18.88	-5.66	-11.55	1.12
Texas	Waller	48473	4.64	3.11	6.03	-4.98	-11.49	2.80
Texas	Ward	48475	9.66	6.67	13.70	-0.40	-12.20	9.18
Texas	Washington	48477	4.08	3.06	5.10	-6.73	-12.83	-0.59
Texas	Webb	48479	6.60	5.25	8.58	-0.96	-7.48	6.63
Texas	Wharton	48481	4.71	3.65	5.93	-0.24	-7.25	6.97
Texas	Wheeler	48483	6.42	4.68	8.11	-0.30	-6.15	6.27
Texas	Wichita	48485	15.21	12.23	19.24	2.48	-3.90	8.65
Texas	Wilbarger	48487	5.90	4.28	7.79	1.21	-7.43	7.87
Texas	Willacy	48489	5.74	4.03	8.43	3.91	-8.41	18.06
Texas	Williamson	48491	3.15	2.49	3.81	-8.14	-13.96	-1.27
Texas	Wilson	48493	7.17	5.37	10.35	-2.30	-11.06	8.47
Texas	Winkler	48495	7.88	5.86	11.60	-1.83	-8.46	8.41
Texas	Wise	48497	4.55	3.26	6.09	-0.84	-9.16	7.05
Texas	Wood	48499	6.08	4.68	8.56	-2.84	-10.91	6.38
Texas	Yoakum	48501	*	*	*	*	*	*
Texas	Young	48503	7.78	5.98	9.68	2.26	-5.49	10.34

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			2017 Rate per 100,000			2013-2017 AAPC		
State	**County**	**FIPS**	**rate**	**95% CI**		**AAPC**	**95% CI**	
Texas	Zapata	48505	4.53	2.86	6.90	-1.84	-13.31	11.08
Texas	Zavala	48507	*	*	*	*	*	*
Utah	Beaver	49001	4.10	2.41	6.38	-8.12	-15.16	2.44
Utah	Box Elder	49003	2.78	2.02	3.87	-2.58	-11.61	5.35
Utah	Cache	49005	*	*	*	*	*	*
Utah	Carbon	49007	3.95	2.66	5.39	-5.12	-14.65	2.27
Utah	Daggett	49009	4.41	3.28	6.18	-0.35	-9.21	9.76
Utah	Davis	49011	1.83	1.27	2.52	-3.10	-10.35	5.77
Utah	Duchesne	49013	3.37	2.33	4.69	-0.99	-13.10	7.65
Utah	Emery	49015	4.37	2.94	5.78	-4.63	-13.30	1.76
Utah	Garfield	49017	2.42	1.85	3.32	-4.10	-10.59	4.69
Utah	Grand	49019	5.18	4.30	6.41	-4.81	-10.94	1.72
Utah	Iron	49021	3.44	2.24	5.20	-4.40	-12.38	5.27
Utah	Juab	49023	3.50	2.76	4.87	-6.41	-14.44	4.82
Utah	Kane	49025	4.57	3.03	6.30	-3.36	-9.51	4.59
Utah	Millard	49027	3.81	2.46	5.05	-7.51	-15.90	3.81
Utah	Morgan	49029	*	*	*	*	*	*
Utah	Piute	49031	3.43	2.52	5.71	-4.07	-14.18	6.42
Utah	Rich	49033	2.65	1.90	3.70	-0.62	-8.55	6.80
Utah	Salt Lake	49035	3.47	2.82	4.41	-6.65	-12.43	-0.49
Utah	San Juan	49037	3.89	3.20	4.62	-4.58	-9.28	-0.29
Utah	Sanpete	49039	3.13	2.23	4.53	-6.16	-13.89	4.99
Utah	Sevier	49041	*	*	*	*	*	*
Utah	Summit	49043	2.61	2.09	3.29	-1.71	-7.64	5.71
Utah	Tooele	49045	3.35	2.39	5.09	-4.60	-11.36	4.17
Utah	Uintah	49047	4.23	3.33	5.48	-1.25	-8.51	5.53
Utah	Utah	49049	1.76	1.32	2.41	-5.08	-11.32	1.85
Utah	Wasatch	49051	*	*	*	*	*	*
Utah	Washington	49053	2.95	2.17	3.84	-3.75	-10.07	5.71
Utah	Wayne	49055	3.27	2.58	4.47	-4.09	-10.13	3.23
Utah	Weber	49057	3.35	2.58	4.44	0.18	-8.38	9.21
Vermont	Addison	50001	2.99	2.14	4.32	-3.34	-11.46	4.16
Vermont	Bennington	50003	4.32	3.35	6.46	-4.81	-10.89	1.88
Vermont	Caledonia	50005	4.27	2.80	6.62	-3.88	-14.05	7.60
Vermont	Chittenden	50007	3.92	2.87	5.40	-2.46	-11.03	7.14
Vermont	Essex	50009	4.35	2.47	6.10	-3.92	-12.67	5.60
Vermont	Franklin	50011	2.84	1.80	4.18	-1.31	-11.94	9.66
Vermont	Grand Isle	50013	3.53	2.40	5.42	-2.61	-15.55	12.96
Vermont	Lamoille	50015	*	*	*	*	*	*
Vermont	Orange	50017	3.08	2.46	4.03	-2.70	-11.91	4.36

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Vermont	Orleans	50019	4.71	2.29	6.51	-5.30	-16.21	3.52
Vermont	Rutland	50021	2.95	1.92	4.00	-4.73	-13.27	5.21
Vermont	Washington	50023	3.91	2.50	5.34	-1.86	-10.32	8.21
Vermont	Windham	50025	4.90	3.80	6.66	-5.00	-12.93	2.94
Vermont	Windsor	50027	4.58	3.42	5.84	-3.91	-11.81	5.05
Virginia	Accomack	51001	2.70	1.81	3.73	-12.14	-21.83	-0.58
Virginia	Albemarle	51003	2.29	1.72	2.89	-2.61	-8.27	3.32
Virginia	Alleghany	51005	3.81	2.69	4.98	0.30	-7.10	8.13
Virginia	Amelia	51007	3.15	2.38	4.10	-6.05	-12.79	0.35
Virginia	Amherst	51009	4.25	3.35	5.40	-0.58	-7.47	6.77
Virginia	Appomattox	51011	*	*	*	*	*	*
Virginia	Arlington	51013	1.57	1.17	1.98	-6.07	-13.95	2.64
Virginia	Augusta	51015	3.20	2.42	4.12	-0.90	-7.18	5.04
Virginia	Bath	51017	3.36	2.37	4.75	1.12	-6.09	7.75
Virginia	Bedford	51019	3.61	2.75	4.61	-1.96	-8.28	8.18
Virginia	Bland	51021	4.19	3.23	5.12	-3.08	-9.19	4.04
Virginia	Botetourt	51023	2.73	2.06	3.63	-1.19	-10.35	10.02
Virginia	Brunswick	51025	3.38	2.57	4.46	-7.03	-12.75	-0.43
Virginia	Buchanan	51027	7.31	4.95	10.42	3.40	-4.35	12.62
Virginia	Buckingham	51029	3.45	2.60	4.56	-5.64	-10.78	2.45
Virginia	Campbell	51031	3.80	2.61	5.21	-3.01	-9.28	3.98
Virginia	Caroline	51033	2.66	2.04	3.41	-5.04	-12.24	4.05
Virginia	Carroll	51035	3.43	2.40	4.59	-2.32	-14.05	7.97
Virginia	Charles City	51036	3.73	3.06	4.76	-4.74	-10.22	1.48
Virginia	Charlotte	51037	3.02	2.50	4.06	-5.09	-13.36	3.55
Virginia	Chesterfield	51041	2.59	2.20	3.10	-3.60	-8.94	2.26
Virginia	Clarke	51043	3.12	2.11	4.14	-5.96	-13.93	2.06
Virginia	Craig	51045	*	*	*	*	*	*
Virginia	Culpeper	51047	2.95	1.86	3.92	-4.44	-11.73	2.68
Virginia	Cumberland	51049	3.14	2.35	4.59	-6.31	-13.07	2.29
Virginia	Dickenson	51051	7.18	4.61	10.61	6.82	-4.98	18.10
Virginia	Dinwiddie	51053	2.58	2.03	3.66	-4.99	-10.01	1.25
Virginia	Essex	51057	3.11	2.36	3.96	-6.79	-13.52	-1.50
Virginia	Fairfax	51059	1.34	1.15	1.57	-4.52	-9.23	0.93
Virginia	Fauquier	51061	2.60	2.07	3.28	-4.30	-11.22	4.64
Virginia	Floyd	51063	3.44	2.71	4.34	-4.96	-12.83	1.87
Virginia	Fluvanna	51065	2.36	1.63	3.30	-5.78	-14.31	0.45
Virginia	Franklin	51067	3.19	2.52	3.87	-2.96	-9.54	4.48
Virginia	Frederick	51069	3.17	2.23	4.29	-4.24	-10.57	3.61
Virginia	Giles	51071	4.17	3.16	5.46	-1.94	-11.06	8.27

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			2017 Rate per 100,000			2013-2017 AAPC		
State	**County**	**FIPS**	**rate**	**95% CI**		**AAPC**	**95% CI**	
Virginia	Gloucester	51073	2.88	2.19	3.75	-5.53	-13.31	3.75
Virginia	Goochland	51075	2.54	2.05	3.26	-3.08	-9.28	4.37
Virginia	Grayson	51077	4.25	3.30	5.84	-1.59	-12.62	10.18
Virginia	Greene	51079	3.27	2.12	4.78	-3.48	-11.51	6.24
Virginia	Greensville	51081	6.20	3.84	8.03	-6.03	-12.49	0.68
Virginia	Halifax	51083	3.11	2.23	4.01	-4.53	-9.98	4.23
Virginia	Hanover	51085	1.98	1.35	2.80	-5.41	-13.88	4.88
Virginia	Henrico	51087	2.74	2.22	3.43	-4.77	-9.17	2.89
Virginia	Henry	51089	3.47	2.70	4.35	-3.32	-10.07	2.52
Virginia	Highland	51091	*	*	*	*	*	*
Virginia	Isle of Wight	51093	2.48	1.38	3.57	-3.59	-13.11	4.09
Virginia	James City	51095	2.26	1.80	2.92	-4.59	-9.41	3.54
Virginia	King and Queen	51097	2.93	2.32	4.06	-3.56	-10.88	3.00
Virginia	King George	51099	3.05	2.36	4.11	-8.21	-16.18	4.25
Virginia	King William	51101	2.78	2.12	3.60	-4.61	-11.05	5.45
Virginia	Lancaster	51103	*	*	*	*	*	*
Virginia	Lee	51105	7.39	5.87	9.47	7.42	-2.22	16.81
Virginia	Loudoun	51107	1.51	1.25	1.91	-2.94	-7.94	2.82
Virginia	Louisa	51109	2.63	1.98	3.23	-4.92	-11.95	0.74
Virginia	Lunenburg	51111	3.06	2.37	3.79	-6.93	-12.54	-0.60
Virginia	Madison	51113	3.26	2.46	4.67	-5.37	-11.18	3.85
Virginia	Mathews	51115	*	*	*	*	*	*
Virginia	Mecklenburg	51117	2.41	1.90	3.13	-4.60	-9.41	1.60
Virginia	Middlesex	51119	3.38	2.34	5.20	-5.45	-15.47	3.62
Virginia	Montgomery	51121	2.64	1.95	3.54	-3.53	-11.47	4.95
Virginia	Nelson	51125	3.03	2.44	4.42	-1.61	-8.35	7.27
Virginia	New Kent	51127	*	*	*	*	*	*
Virginia	Northampton	51131	*	*	*	*	*	*
Virginia	Northumberland	51133	*	*	*	*	*	*
Virginia	Nottoway	51135	3.27	2.36	4.24	-7.48	-13.43	0.01
Virginia	Orange	51137	2.69	2.04	4.05	-3.81	-9.86	3.20
Virginia	Page	51139	3.90	2.46	5.89	-1.26	-9.42	10.68
Virginia	Patrick	51141	3.25	2.55	4.35	-4.47	-10.87	2.33
Virginia	Pittsylvania	51143	3.46	2.58	4.20	-4.93	-10.44	0.50
Virginia	Powhatan	51145	3.08	2.26	4.29	-7.82	-16.11	1.01
Virginia	Prince Edward	51147	2.87	2.38	3.73	-7.04	-13.41	2.69
Virginia	Prince George	51149	2.70	2.09	3.27	-3.42	-10.16	1.60
Virginia	Prince William	51153	1.75	1.36	2.24	-3.64	-10.78	2.12
Virginia	Pulaski	51155	3.20	2.55	5.03	-4.19	-10.42	5.87
Virginia	Rappahannock	51157	3.77	2.51	5.02	-4.01	-11.87	8.38

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State	**County**	**FIPS**	**rate**	**95% CI**		**AAPC**	**95% CI**	
Virginia	Richmond	51159	2.79	2.07	4.31	-8.62	-16.37	1.99
Virginia	Roanoke	51161	3.30	2.52	4.16	-0.20	-8.09	8.75
Virginia	Rockbridge	51163	3.58	2.58	4.40	1.37	-4.61	7.84
Virginia	Rockingham	51165	1.93	1.35	2.79	1.33	-6.83	10.27
Virginia	Russell	51167	4.42	3.29	6.01	2.34	-4.23	11.40
Virginia	Scott	51169	5.10	3.80	6.71	1.23	-7.34	10.90
Virginia	Shenandoah	51171	3.46	1.94	4.63	-2.84	-12.12	6.19
Virginia	Smyth	51173	4.07	2.71	5.84	-2.39	-10.59	6.74
Virginia	Southampton	51175	3.80	3.07	4.74	-3.96	-9.04	1.36
Virginia	Spotsylvania	51177	2.09	1.44	2.81	-4.88	-11.71	3.27
Virginia	Stafford	51179	2.20	1.50	2.68	-3.81	-10.33	5.09
Virginia	Surry	51181	3.14	2.23	4.49	-5.05	-10.48	4.38
Virginia	Sussex	51183	4.10	3.07	5.86	-4.38	-12.16	7.25
Virginia	Tazewell	51185	5.52	3.81	7.96	-0.90	-8.02	9.23
Virginia	Warren	51187	4.52	3.35	5.82	-5.28	-13.09	2.07
Virginia	Washington	51191	3.90	2.88	5.18	-4.38	-13.94	5.03
Virginia	Westmoreland	51193	2.70	1.99	4.47	-8.38	-15.69	2.32
Virginia	Wise	51195	6.18	4.02	8.51	5.72	-5.99	14.09
Virginia	Wythe	51197	3.53	2.31	5.53	-1.15	-10.67	15.64
Virginia	York	51199	2.19	1.71	3.37	-3.03	-12.57	5.58
Virginia	Alexandria	51510	2.84	2.18	3.87	-5.74	-14.24	5.94
Virginia	Bristol	51520	5.07	3.67	7.63	-4.29	-13.35	6.50
Virginia	Buena Vista	51530	*	*	*	*	*	*
Virginia	Charlottesville	51540	*	*	*	*	*	*
Virginia	Chesapeake	51550	3.21	2.51	3.93	-0.96	-8.98	6.06
Virginia	Colonial Heights	51570	3.34	2.04	4.62	-0.73	-10.02	8.50
Virginia	Covington	51580	*	*	*	*	*	*
Virginia	Danville	51590	4.77	3.16	7.35	-4.70	-16.85	7.74
Virginia	Emporia	51595	*	*	*	*	*	*
Virginia	Fairfax City	51600	*	*	*	*	*	*
Virginia	Falls Church	51610	1.66	1.25	2.31	-8.29	-16.16	2.24
Virginia	Franklin City	51620	*	*	*	*	*	*
Virginia	Fredericksburg	51630	2.53	1.57	3.38	-3.66	-14.33	6.75
Virginia	Galax	51640	5.61	3.73	8.31	0.74	-14.16	16.77
Virginia	Hampton	51650	7.16	5.49	10.23	-0.34	-9.62	11.18
Virginia	Harrisonburg	51660	*	*	*	*	*	*
Virginia	Hopewell	51670	3.92	2.99	5.05	-5.36	-10.60	3.39
Virginia	Lexington	51678	*	*	*	*	*	*
Virginia	Lynchburg	51680	5.16	3.55	7.28	-0.48	-9.97	9.96
Virginia	Martinsville	51690	5.02	3.02	6.68	-1.18	-15.10	8.58

Abbreviation: AAPC, average annual percent change; CI, confidence interval
*Indicates at least one unreliable rate between 2013 and 2017.

State	County	FIPS	2017 Rate per 100,000 rate	95% CI		2013-2017 AAPC AAPC	95% CI	
Virginia	Newport News	51700	6.52	4.87	8.83	-0.74	-8.54	8.98
Virginia	Norfolk	51710	5.96	4.44	7.93	-4.47	-12.80	3.32
Virginia	Norton	51720	*	*	*	*	*	*
Virginia	Petersburg	51730	3.92	2.75	5.77	-3.96	-10.93	4.20
Virginia	Portsmouth	51740	6.09	3.88	7.99	-5.16	-16.18	2.69
Virginia	Radford	51750	*	*	*	*	*	*
Virginia	Richmond City	51760	5.78	4.14	7.59	-7.30	-14.32	1.00
Virginia	Roanoke City	51770	10.42	7.69	13.91	-2.20	-10.25	8.06
Virginia	Salem	51775	*	*	*	*	*	*
Virginia	Staunton	51790	*	*	*	*	*	*
Virginia	Suffolk	51800	3.14	2.37	3.82	-0.20	-7.15	6.13
Virginia	Virginia Beach	51810	2.68	2.18	3.60	-2.83	-9.80	3.66
Virginia	Waynesboro	51820	*	*	*	*	*	*
Virginia	Williamsburg	51830	*	*	*	*	*	*
Virginia	Winchester	51840	*	*	*	*	*	*
Washington	Adams	53001	3.78	2.22	5.41	-3.54	-15.80	4.53
Washington	Asotin	53003	*	*	*	*	*	*
Washington	Benton	53005	5.47	4.38	6.71	-6.04	-13.76	-0.13
Washington	Chelan	53007	4.12	2.89	6.53	-7.01	-16.05	1.28
Washington	Clallam	53009	5.22	3.62	7.63	-6.81	-15.86	5.89
Washington	Clark	53011	7.03	5.57	8.56	-2.56	-9.13	3.72
Washington	Columbia	53013	4.74	3.44	6.48	-9.00	-15.97	0.38
Washington	Cowlitz	53015	12.13	9.35	15.54	-1.12	-7.43	5.72
Washington	Douglas	53017	*	*	*	*	*	*
Washington	Ferry	53019	6.49	4.03	9.27	-6.33	-16.45	1.68
Washington	Franklin	53021	5.09	3.58	6.95	-6.94	-15.14	1.95
Washington	Garfield	53023	3.45	2.27	5.11	-5.90	-13.46	1.75
Washington	Grant	53025	6.11	4.94	8.95	-4.75	-11.41	1.85
Washington	Grays Harbor	53027	8.68	6.91	11.30	-6.79	-13.58	0.25
Washington	Island	53029	4.39	2.71	5.97	-6.88	-16.64	4.61
Washington	Jefferson	53031	6.42	4.80	8.13	-8.38	-15.48	-1.12
Washington	King	53033	5.43	4.73	6.17	-8.03	-11.89	-4.52
Washington	Kitsap	53035	4.13	3.21	5.27	-14.26	-21.24	-6.86
Washington	Kittitas	53037	5.00	3.56	6.75	-5.94	-13.87	0.87
Washington	Klickitat	53039	6.56	4.85	9.57	-2.22	-9.17	5.00
Washington	Lewis	53041	6.57	4.93	8.41	-5.90	-11.03	-0.81
Washington	Lincoln	53043	3.41	2.50	5.44	-4.91	-13.75	1.86
Washington	Mason	53045	7.73	5.58	9.56	-9.65	-16.47	-1.80
Washington	Okanogan	53047	5.61	4.38	7.14	-5.40	-12.11	1.33
Washington	Pacific	53049	9.56	6.43	13.21	-5.74	-16.40	2.93

Abbreviation: AAPC, average annual percent change; CI, confidence interval
*Indicates at least one unreliable rate between 2013 and 2017.

			2017 Rate per 100,000			2013-2017 AAPC		
State	**County**	**FIPS**	**rate**	**95% CI**		**AAPC**	**95% CI**	
Washington	Pend Oreille	53051	6.64	4.60	9.12	-8.40	-17.66	1.46
Washington	Pierce	53053	6.07	5.20	7.26	-7.23	-12.14	-2.59
Washington	San Juan	53055	5.14	3.49	7.46	-4.94	-11.55	4.96
Washington	Skagit	53057	6.73	5.20	8.98	-6.82	-13.83	1.67
Washington	Skamania	53059	6.41	5.01	9.10	-2.07	-9.63	5.36
Washington	Snohomish	53061	5.18	4.11	6.38	-5.64	-11.58	0.17
Washington	Spokane	53063	5.42	4.49	6.38	-5.88	-12.32	0.39
Washington	Stevens	53065	5.35	3.63	6.99	-5.74	-12.56	1.95
Washington	Thurston	53067	4.78	3.65	6.46	-9.15	-15.35	-0.53
Washington	Wahkiakum	53069	7.76	5.84	9.88	-2.91	-11.63	6.46
Washington	Walla Walla	53071	6.84	4.74	9.60	-10.85	-20.97	-0.26
Washington	Whatcom	53073	6.24	5.13	8.11	-3.72	-11.57	4.41
Washington	Whitman	53075	3.66	3.01	4.53	-6.12	-11.95	0.55
Washington	Yakima	53077	7.26	5.74	8.96	-5.06	-11.19	1.18
West Virginia	Barbour	54001	3.21	2.28	4.51	4.67	-7.20	14.21
West Virginia	Berkeley	54003	4.53	3.10	5.85	-4.70	-13.02	2.30
West Virginia	Boone	54005	4.90	2.93	7.42	1.78	-7.55	16.78
West Virginia	Braxton	54007	*	*	*	*	*	*
West Virginia	Brooke	54009	2.36	1.64	3.64	-4.29	-12.79	6.79
West Virginia	Cabell	54011	7.10	5.29	9.81	-0.29	-6.59	7.94
West Virginia	Calhoun	54013	5.47	4.00	7.78	0.72	-7.29	10.02
West Virginia	Clay	54015	5.11	3.19	7.84	0.31	-8.23	11.64
West Virginia	Doddridge	54017	3.52	2.09	5.05	7.15	-2.45	16.57
West Virginia	Fayette	54019	5.91	4.61	7.53	1.03	-5.30	8.99
West Virginia	Gilmer	54021	5.16	3.76	7.76	3.91	-4.86	12.00
West Virginia	Grant	54023	3.10	2.15	4.14	-0.58	-8.53	7.72
West Virginia	Greenbrier	54025	4.38	2.56	5.94	1.99	-6.08	9.04
West Virginia	Hampshire	54027	2.96	2.08	4.02	-3.37	-11.06	5.07
West Virginia	Hancock	54029	2.23	1.48	3.16	-2.22	-13.53	6.67
West Virginia	Hardy	54031	2.96	1.86	3.99	-0.74	-10.69	7.20
West Virginia	Harrison	54033	5.22	3.77	7.64	4.96	-4.86	13.24
West Virginia	Jackson	54035	2.73	1.96	3.69	2.32	-6.75	9.86
West Virginia	Jefferson	54037	3.08	1.99	4.80	-5.31	-12.81	5.15
West Virginia	Kanawha	54039	5.19	3.90	6.60	-2.08	-7.79	4.29
West Virginia	Lewis	54041	7.17	4.39	9.75	5.94	-3.27	15.23
West Virginia	Lincoln	54043	4.64	3.08	6.70	2.29	-4.04	9.62
West Virginia	Logan	54045	7.66	4.44	11.49	4.58	-6.42	18.71
West Virginia	McDowell	54047	*	*	*	*	*	*
West Virginia	Marion	54049	*	*	*	*	*	*
West Virginia	Marshall	54051	3.06	2.25	4.77	-1.88	-8.62	6.77

Abbreviation: AAPC, average annual percent change; CI, confidence interval
*Indicates at least one unreliable rate between 2013 and 2017.

			2017 Rate per 100,000			2013-2017 AAPC		
State	**County**	**FIPS**	**rate**	**95% CI**		**AAPC**	**95% CI**	
West Virginia	Mason	54053	3.35	2.00	4.49	4.05	-4.92	12.47
West Virginia	Mercer	54055	5.60	4.02	7.02	-2.18	-8.54	4.07
West Virginia	Mineral	54057	2.71	2.00	3.50	-1.65	-9.08	5.92
West Virginia	Mingo	54059	6.75	4.41	9.50	3.48	-4.08	10.74
West Virginia	Monongalia	54061	3.78	2.76	5.05	1.91	-4.82	8.24
West Virginia	Monroe	54063	3.88	2.79	5.56	-1.05	-9.29	7.45
West Virginia	Morgan	54065	3.57	2.86	5.07	-1.71	-9.98	9.30
West Virginia	Nicholas	54067	*	*	*	*	*	*
West Virginia	Ohio	54069	2.72	1.78	3.74	-2.69	-11.35	6.84
West Virginia	Pendleton	54071	2.07	1.64	3.20	0.29	-8.98	9.26
West Virginia	Pleasants	54073	4.00	2.71	5.36	2.90	-4.97	14.33
West Virginia	Pocahontas	54075	2.95	2.02	4.24	3.12	-5.34	11.51
West Virginia	Preston	54077	3.28	2.43	4.26	3.31	-4.12	11.39
West Virginia	Putnam	54079	3.56	2.25	5.17	3.06	-6.83	11.34
West Virginia	Raleigh	54081	5.77	4.45	7.79	1.24	-6.51	7.94
West Virginia	Randolph	54083	*	*	*	*	*	*
West Virginia	Ritchie	54085	3.00	2.30	4.08	6.41	-0.15	13.56
West Virginia	Roane	54087	4.90	3.34	6.39	-3.00	-11.89	5.21
West Virginia	Summers	54089	4.71	3.54	6.28	0.37	-6.81	10.78
West Virginia	Taylor	54091	3.80	2.76	5.32	6.57	-5.16	14.52
West Virginia	Tucker	54093	4.12	2.62	5.91	2.61	-6.58	10.83
West Virginia	Tyler	54095	*	*	*	*	*	*
West Virginia	Upshur	54097	*	*	*	*	*	*
West Virginia	Wayne	54099	5.14	3.74	7.42	3.84	-3.98	12.27
West Virginia	Webster	54101	3.77	2.96	4.84	1.19	-6.18	8.95
West Virginia	Wetzel	54103	3.27	2.56	4.27	1.34	-4.57	7.96
West Virginia	Wirt	54105	*	*	*	*	*	*
West Virginia	Wood	54107	2.32	1.71	2.82	5.37	-4.46	13.53
West Virginia	Wyoming	54109	6.29	4.46	8.26	0.38	-8.62	10.16
Wisconsin	Adams	55001	2.67	1.84	3.65	-5.52	-13.54	3.89
Wisconsin	Ashland	55003	2.75	2.09	4.20	-0.78	-9.85	7.50
Wisconsin	Barron	55005	2.02	1.48	2.58	-0.60	-7.13	8.28
Wisconsin	Bayfield	55007	*	*	*	*	*	*
Wisconsin	Brown	55009	1.59	1.26	2.02	-5.63	-12.10	1.35
Wisconsin	Buffalo	55011	2.15	1.55	3.02	-6.35	-16.97	1.36
Wisconsin	Burnett	55013	2.67	2.03	3.52	-2.05	-9.62	6.69
Wisconsin	Calumet	55015	1.31	0.89	2.04	-5.94	-13.64	0.86
Wisconsin	Chippewa	55017	2.10	1.59	2.65	-4.80	-10.59	2.26
Wisconsin	Clark	55019	1.93	1.19	2.79	-3.62	-10.17	3.35
Wisconsin	Columbia	55021	2.04	1.54	2.75	-8.34	-15.93	-0.29

Abbreviation: AAPC, average annual percent change; CI, confidence interval
*Indicates at least one unreliable rate between 2013 and 2017.

			2017 Rate per 100,000			2013-2017 AAPC		
State	**County**	**FIPS**	**rate**	**95% CI**		**AAPC**	**95% CI**	
Wisconsin	Crawford	55023	*	*	*	*	*	*
Wisconsin	Dane	55025	2.05	1.53	2.93	-8.44	-15.28	0.36
Wisconsin	Dodge	55027	1.99	1.50	2.77	-9.44	-16.59	-0.31
Wisconsin	Door	55029	*	*	*	*	*	*
Wisconsin	Douglas	55031	3.05	2.24	4.08	-1.17	-10.66	6.74
Wisconsin	Dunn	55033	1.63	1.24	2.52	-3.92	-10.16	8.42
Wisconsin	Eau Claire	55035	1.96	1.45	2.50	-3.76	-11.20	5.56
Wisconsin	Florence	55037	*	*	*	*	*	*
Wisconsin	Fond du Lac	55039	1.76	1.08	2.44	-7.18	-16.19	1.00
Wisconsin	Forest	55041	1.84	1.48	2.50	-5.79	-12.83	1.72
Wisconsin	Grant	55043	1.51	0.93	2.00	-5.76	-14.93	3.76
Wisconsin	Green	55045	*	*	*	*	*	*
Wisconsin	Green Lake	55047	*	*	*	*	*	*
Wisconsin	Iowa	55049	1.93	1.32	2.92	-5.93	-13.06	3.42
Wisconsin	Iron	55051	3.42	2.43	5.22	-4.82	-15.05	3.05
Wisconsin	Jackson	55053	2.14	1.45	3.06	-5.90	-12.58	1.97
Wisconsin	Jefferson	55055	1.31	0.89	1.94	-7.11	-16.34	2.21
Wisconsin	Juneau	55057	*	*	*	*	*	*
Wisconsin	Kenosha	55059	2.04	1.57	2.67	-4.70	-11.93	3.34
Wisconsin	Kewaunee	55061	*	*	*	*	*	*
Wisconsin	La Crosse	55063	1.85	1.36	2.65	-4.68	-10.66	3.56
Wisconsin	Lafayette	55065	1.96	1.28	2.83	-3.90	-12.42	2.66
Wisconsin	Langlade	55067	2.24	1.46	3.39	-5.48	-11.35	1.84
Wisconsin	Lincoln	55069	2.28	1.65	3.15	-0.74	-9.48	7.99
Wisconsin	Manitowoc	55071	1.60	1.21	2.02	-3.49	-11.80	7.53
Wisconsin	Marathon	55073	1.50	1.07	2.07	-4.84	-10.56	0.87
Wisconsin	Marinette	55075	1.61	1.15	2.31	-5.25	-14.89	9.86
Wisconsin	Marquette	55077	1.73	1.14	2.51	-4.90	-12.67	1.93
Wisconsin	Menominee	55078	4.73	2.37	6.78	-3.00	-13.12	5.25
Wisconsin	Milwaukee	55079	4.65	3.97	5.64	-2.41	-8.12	3.59
Wisconsin	Monroe	55081	2.32	1.82	3.06	-7.52	-14.14	2.77
Wisconsin	Oconto	55083	1.44	0.97	2.14	-7.16	-14.17	3.82
Wisconsin	Oneida	55085	*	*	*	*	*	*
Wisconsin	Outagamie	55087	1.49	1.12	2.00	-5.35	-12.33	1.26
Wisconsin	Ozaukee	55089	1.71	0.86	2.26	-0.21	-13.30	7.69
Wisconsin	Pepin	55091	1.96	1.31	2.54	-6.80	-13.63	2.69
Wisconsin	Pierce	55093	1.83	1.08	2.49	-4.04	-11.50	4.50
Wisconsin	Polk	55095	2.11	1.65	2.72	-2.87	-10.61	6.13
Wisconsin	Portage	55097	1.99	1.49	2.65	-4.38	-12.55	3.17
Wisconsin	Price	55099	2.33	1.61	3.16	-1.43	-8.88	6.67

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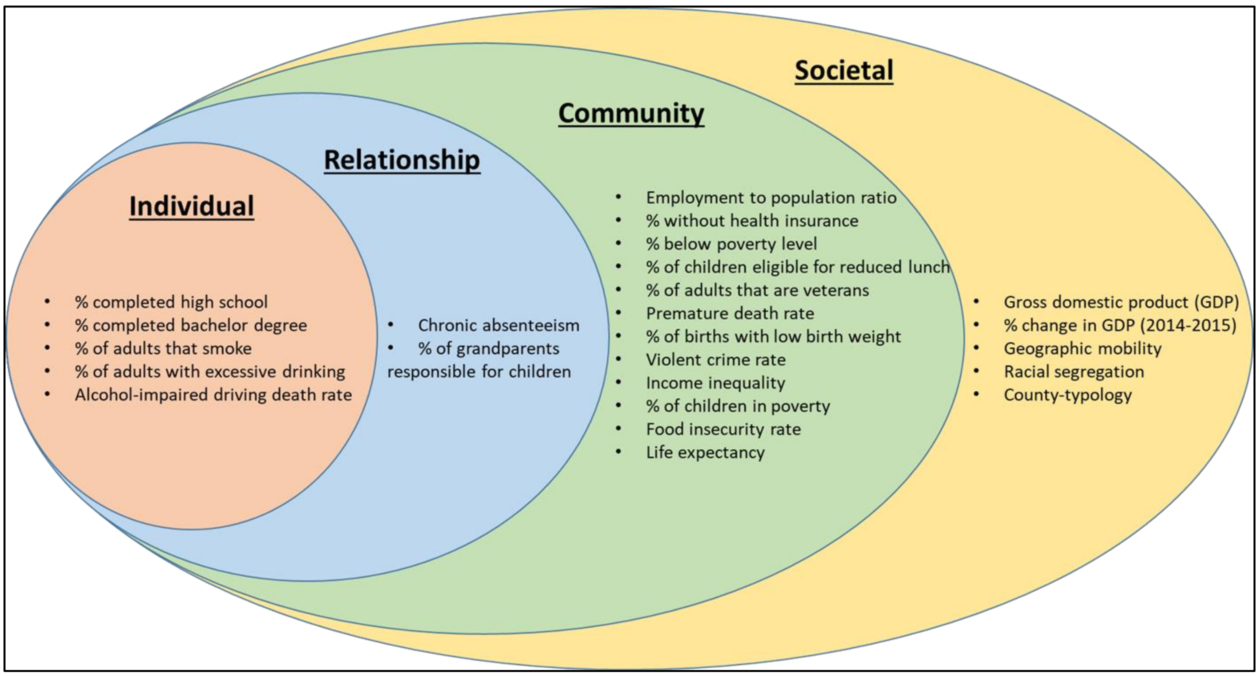
			2017 Rate per 100,000			2013-2017 AAPC		
State	**County**	**FIPS**	**rate**	**95% CI**		**AAPC**	**95% CI**	
Wisconsin	Racine	55101	2.13	1.57	2.76	-7.55	-14.28	0.86
Wisconsin	Richland	55103	*	*	*	*	*	*
Wisconsin	Rock	55105	1.72	1.32	2.59	-8.49	-14.54	-2.13
Wisconsin	Rusk	55107	2.69	1.96	3.43	-2.51	-9.26	4.18
Wisconsin	St. Croix	55109	1.59	1.09	2.04	-1.04	-10.32	8.74
Wisconsin	Sauk	55111	1.75	1.19	2.54	-6.50	-15.75	0.37
Wisconsin	Sawyer	55113	2.83	2.12	3.56	-1.31	-8.57	6.14
Wisconsin	Shawano	55115	1.62	1.18	2.49	-5.63	-11.08	1.08
Wisconsin	Sheboygan	55117	1.37	0.92	1.81	-4.48	-11.68	3.64
Wisconsin	Taylor	55119	2.02	1.51	3.07	-3.43	-10.01	6.19
Wisconsin	Trempealeau	55121	1.82	1.21	2.65	-6.80	-14.00	3.91
Wisconsin	Vernon	55123	*	*	*	*	*	*
Wisconsin	Vilas	55125	*	*	*	*	*	*
Wisconsin	Walworth	55127	1.58	1.30	2.04	-7.30	-14.28	0.76
Wisconsin	Washburn	55129	2.52	1.93	3.72	-1.14	-8.14	6.42
Wisconsin	Washington	55131	1.48	1.05	1.87	-4.94	-11.13	1.71
Wisconsin	Waukesha	55133	1.13	0.73	1.50	-3.32	-13.44	5.27
Wisconsin	Waupaca	55135	1.60	1.16	2.25	-7.06	-15.23	1.90
Wisconsin	Waushara	55137	2.04	1.40	2.99	-5.47	-12.45	2.17
Wisconsin	Winnebago	55139	1.82	1.37	2.50	-6.39	-14.63	0.61
Wisconsin	Wood	55141	1.99	1.20	2.88	-4.73	-13.21	5.51
Wyoming	Albany	56001	5.29	4.20	6.96	-1.09	-7.11	6.86
Wyoming	Big Horn	56003	3.83	2.66	5.28	-1.96	-14.65	9.03
Wyoming	Campbell	56005	4.26	3.15	5.50	0.25	-7.37	10.78
Wyoming	Carbon	56007	5.45	4.05	7.27	-0.55	-7.07	6.62
Wyoming	Converse	56009	5.70	4.13	8.00	0.16	-8.26	8.60
Wyoming	Crook	56011	3.26	2.44	4.64	-2.00	-9.99	7.01
Wyoming	Fremont	56013	4.46	3.44	6.18	-1.18	-7.90	6.36
Wyoming	Goshen	56015	4.68	3.46	5.77	2.17	-5.14	16.30
Wyoming	Hot Springs	56017	5.50	3.29	8.46	-3.11	-11.76	10.61
Wyoming	Johnson	56019	5.37	3.61	7.54	-0.01	-10.60	11.59
Wyoming	Laramie	56021	4.69	3.69	6.28	-2.11	-10.20	5.66
Wyoming	Lincoln	56023	2.58	1.82	3.29	-1.64	-8.78	8.03
Wyoming	Natrona	56025	6.08	4.33	7.98	1.44	-7.05	8.48
Wyoming	Niobrara	56027	4.97	3.62	7.71	-0.80	-8.06	13.08
Wyoming	Park	56029	3.17	2.36	4.68	-1.91	-8.61	7.58
Wyoming	Platte	56031	*	*	*	*	*	*
Wyoming	Sheridan	56033	4.18	2.99	5.61	3.55	-6.57	15.54
Wyoming	Sublette	56035	3.39	2.21	4.59	-5.12	-15.07	3.96
Wyoming	Sweetwater	56037	3.87	2.94	4.91	-2.94	-10.35	4.28

Abbreviation: AAPC, average annual percent change; CI, confidence interval
*Indicates at least one unreliable rate between 2013 and 2017.

State	County	FIPS	2017 Rate per 100,000 rate	95% CI		2013-2017 AAPC AAPC	95% CI	
Wyoming	Teton	56039	2.76	2.07	3.44	-2.71	-8.84	3.06
Wyoming	Uinta	56041	3.41	2.34	4.50	-1.95	-10.93	9.19
Wyoming	Washakie	56043	4.35	3.15	6.43	-0.20	-9.85	12.65
Wyoming	Weston	56045	3.95	3.00	6.10	0.83	-6.23	11.92

Appendix B: Supplemental Material for Chapter 3

Supplemental Figure 1. Social-ecological model framework used to identify county-level indicators hypothesized to be associated with prescription opioid availability



Citation for social-ecological model: Krieger et al.[140]

Abbreviation: AAPC, average annual percent change; CI, confidence interval
*Indicates at least one unreliable rate between 2013 and 2017.

Supplemental Table 2. Items included in latent profile analysis of county-level indicator variables associated with opioid prescription rates

Item	# Missing	Years
U.S. Department of Agriculture[141]		
Economic Research Service County Typology Code	2	2015
U.S. Bureau of Economic Analysis[142]		
Gross Domestic Product ($ per 100,000,000 population)	0	2015
Proportion change in GDP from 2014 to 2015	0	2014-2015
U.S. Department of Education[143]		
Proportion of public school students (K-12) absent 15 or more days	7	2015-2016
American Community Survey[145]		
Proportion ≥25 years that completed high school	0	2013-2017
Proportion ≥25 years that completed a bachelor's degree	0	2013-2017
Proportion of housing units that were moved into 2015 or later	0	2013-2017
Proportion of housing units that are mobile homes	0	2013-2017
Employment to population ratio for 16 to 64 year olds	0	2013-2017
Proportion without health insurance coverage	0	2013-2017
Proportion below poverty level in last 12 months	0	2013-2017
Proportion of grandparents responsible for their grandchildren	0	2013-2017
Index of Concentration at the Extremes (Race)[206]	0	2013-2017
Robert Wood Johnson County Health Rankings[144]		
Premature death (YPLL before 75 years per 1,000,000)	61	2015-2017
Proportion of adults that smoke	0	2016
Proportion of children under 18 years in poverty	1	2017
Proportion of births with low birthweight	107	2011-2017
Violent crime offenses (per 100,000)	191	2016
Income inequality raw value (ratio of 80th to 20th percentile)	0	2013-2017
Proportion of adults that report excessive drinking	0	2016
Proportion of children eligible for reduced price lunch	121	2016-2017
Proportion of driving deaths involving alcohol	33	2013-2017
Proportion of households with a severe housing problem	0	2011-2015
Proportion of population without adequate access to food	0	2016
Life expectancy from birth (in years)	69	2015-2017

Abbreviations: YPLL: Years of potential life lost

Supplemental Table 3. Comparison of models considered in latent profile analysis of county-level indicator variables associated with opioid prescription rates

# of Classes	Correlation[a]	AIC	aBIC	Entropy	Min Class Size	Max Class Size	Min Class P	Max Class P	Global Solution
5	None	-97371.9	-96805.5	0.928	362	1082	0.928	0.973	Yes
6	None	-99706.6	-99039.5	0.916	254	945	0.926	0.974	Yes
7	None	-101648.6	-100880.9	0.923	88	929	0.927	0.984	Yes
8	None	-103368.8	-102500.5	0.929	89	875	0.922	0.989	Yes
9	None	-104447.6	-103478.7	0.927	88	816	0.886	0.986	Yes
10	None	-105403.3	-104333.8	0.931	59	805	0.886	0.983	Yes
11	None	-106194.8	-105024.6	0.924	73	735	0.901	0.977	No
12	None	-107095.9	-105825.1	0.925	57	594	0.880	0.983	Yes
6	>|0.7|	-105967.1	-105274.2	0.903	235	997	0.916	0.973	Yes
7	>|0.7|	-107746.0	-106952.4	0.916	123	952	0.919	0.980	Yes
8	>|0.7|	-109863.8	-108969.6	0.924	26	952	0.921	0.998	No
9	>|0.7|	-110905.6	-109910.8	0.917	26	877	0.894	0.998	No

Note: Selected model is highlighted in grey.
Abbreviations: AIC, Akaike information criterion; BIC, Bayesian information criterion; aBIC, adjusted Bayesian criterion; Min, minimum; Max, maximum; P, probability.
[a]Models that list "none" under correlation did not allow indicators to correlate within classes. Models that list ">|0.7|" Allowed all pairs of indicators that had correlation coefficients stronger than 0.7 to correlate within classes. The following pairs of indicators fit that criteria: Children in poverty *with* inadequate access to food, children eligible for reduced price lunch, employment to population ratio and poverty in last year; poverty in last year *with* inadequate access to food, children eligible for reduced price lunch and employment to population ratio; life expectancy *with* premature death and adults that smoke.

Supplemental Table 4. County-level characteristics of 3,142 U.S. counties, by latent class

	Average Counties		**Farming/Mining**		**Farm-dependent**		**Poverty 1**		**Poverty 2**		**High education**		**High GDP**	
	n=952		n=123		n=559		n=318		n=576		n=395		n=219	
Categorical Variables	**n**	**Col %**	**n**	**Col %**	**n**	**Col %**	**n**	**Col %**	**n**	**Col %**	**n**	**Col %**	**n**	**Col %**
County Typology														
Nonspecialized	379	39.8	22	17.9	137	24.5	145	45.6	218	37.8	205	51.9	129	58.9
Farm-dependent	66	6.9	38	30.9	249	44.5	24	7.5	67	11.6	0	0.0	0	0.0
Mining-dependent	88	9.2	26	21.1	20	3.6	12	3.8	63	10.9	5	1.3	7	3.2
Manufacturing-dependent	165	17.3	17	13.8	105	18.8	67	21.1	114	19.8	22	5.6	11	5.0
Federal/State government	114	12.0	18	14.6	11	2.0	62	19.5	76	13.2	66	16.7	59	26.9
Recreation	140	14.7	2	1.6	37	6.6	6	1.9	38	6.6	97	24.6	13	5.9
Missing	0	0.0	0	0.0	0	0.0	2	0.6	0	0.0	0	0.0	0	0.0
Gross Domestic Product ($ per 1,000 population)														
<200,000	95	10.0	31	25.2	154	27.5	72	22.6	135	23.4	5	1.3	0	0.0
200,000 to 400,000	127	13.3	12	9.8	123	22.0	77	24.2	141	24.5	9	2.3	0	0.0
400,000 to 700,000	140	14.7	17	13.8	107	19.1	78	24.5	105	18.2	16	4.1	2	0.9
700,000 to 1,300,000	196	20.6	33	26.8	92	16.5	46	14.5	115	20.0	22	5.6	3	1.4
1,300,000 to 2,000,000	130	13.7	8	6.5	47	8.4	17	5.3	47	8.2	23	5.8	11	5.0
2,000,000 to 5,000,000	193	20.3	5	4.1	32	5.7	26	8.2	31	5.4	84	21.3	40	18.3
>5,000,000	71	7.5	17	13.8	4	0.7	2	0.6	2	0.3	236	59.7	163	74.4
Continuous Variables	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
P of households with a severe housing problem	0.135	0.029	0.168	0.051	0.104	0.025	0.171	0.036	0.136	0.028	0.160	0.043	0.197	0.048
Life expectancy from birth (in years)	77.434	1.697	78.575	2.402	79.355	1.753	73.944	2.315	75.078	2.068	80.766	2.277	77.616	1.972
P of population without adequate access to food	0.131	0.021	0.106	0.027	0.101	0.018	0.213	0.038	0.157	0.024	0.108	0.027	0.163	0.032
P of children eligible for reduced price lunch	0.520	0.086	0.690	0.115	0.390	0.087	0.824	0.164	0.631	0.132	0.347	0.099	0.599	0.123
P of public school students (K-12) absent ≥15 days	0.150	0.076	0.130	0.077	0.103	0.047	0.155	0.077	0.159	0.077	0.143	0.057	0.169	0.075

P of grandparents responsible for grandchildren	0.484	0.141	0.457	0.177	0.464	0.190	0.567	0.134	0.556	0.142	0.341	0.115	0.420	0.108
P >25 years that completed high school	0.877	0.030	0.706	0.061	0.913	0.025	0.792	0.043	0.812	0.038	0.924	0.027	0.871	0.037
P >25 years that completed a bachelor's degree	0.199	0.047	0.142	0.041	0.215	0.043	0.141	0.036	0.141	0.032	0.379	0.085	0.288	0.076
P of housing units that were moved into ≥2015	0.089	0.023	0.089	0.023	0.079	0.020	0.075	0.023	0.078	0.022	0.108	0.030	0.124	0.028
P of housing units that are mobile homes	0.117	0.059	0.156	0.083	0.065	0.041	0.241	0.095	0.227	0.085	0.045	0.035	0.062	0.055
Employment to population ratio	66.070	5.781	63.425	8.402	76.416	4.072	53.519	7.816	57.802	6.919	73.192	4.459	66.200	4.601
P without health insurance coverage	0.105	0.036	0.207	0.065	0.070	0.027	0.150	0.051	0.132	0.043	0.079	0.032	0.121	0.035
P below poverty level in last 12 months	0.146	0.029	0.191	0.069	0.103	0.026	0.267	0.063	0.200	0.039	0.107	0.042	0.184	0.046
Index of Concentration at the Extremes (Race)	0.854	0.118	0.808	0.130	0.939	0.047	0.281	0.205	0.770	0.195	0.786	0.157	0.450	0.226
P change in GDP from 2014 to 2015	0.047	0.056	0.081	0.082	0.044	0.041	0.046	0.047	0.052	0.058	0.040	0.036	0.031	0.024
Premature death (YPLL before 75 years/1,000,000)	1.010	0.181	0.914	0.203	0.816	0.195	1.472	0.338	1.292	0.228	0.704	0.144	1.006	0.191
Violent crime offenses (per 100,000)	1.073	0.610	1.310	0.826	0.647	0.469	2.019	1.273	1.203	0.802	1.012	0.585	2.556	1.181
P of births with low birthweight	0.076	0.012	0.075	0.014	0.064	0.012	0.114	0.020	0.089	0.015	0.071	0.012	0.091	0.015
P of adults that smoke	0.177	0.026	0.163	0.020	0.154	0.015	0.223	0.033	0.204	0.028	0.144	0.024	0.177	0.027
P of adults that report excessive drinking	0.176	0.024	0.169	0.019	0.200	0.026	0.139	0.020	0.151	0.022	0.203	0.028	0.179	0.023
P of driving deaths involving alcohol	0.286	0.129	0.253	0.147	0.326	0.185	0.300	0.146	0.274	0.126	0.304	0.123	0.282	0.079
P of children under 18 years in poverty	0.199	0.044	0.266	0.083	0.139	0.039	0.371	0.076	0.283	0.052	0.114	0.038	0.229	0.052
Income inequality raw value (80th/20th percentile)	4.307	0.445	4.566	0.867	3.977	0.405	5.479	0.784	4.794	0.539	4.335	0.606	5.047	0.824

Abbreviations: GDP, gross domestic product; n, number; Col, column; P, proportion; SD, standard deviation; YPLL, years of potential life lost. Latent classes were defined by a seven class model that was selected through a latent profile analysis of county level indicators associated with opioid prescription rates.

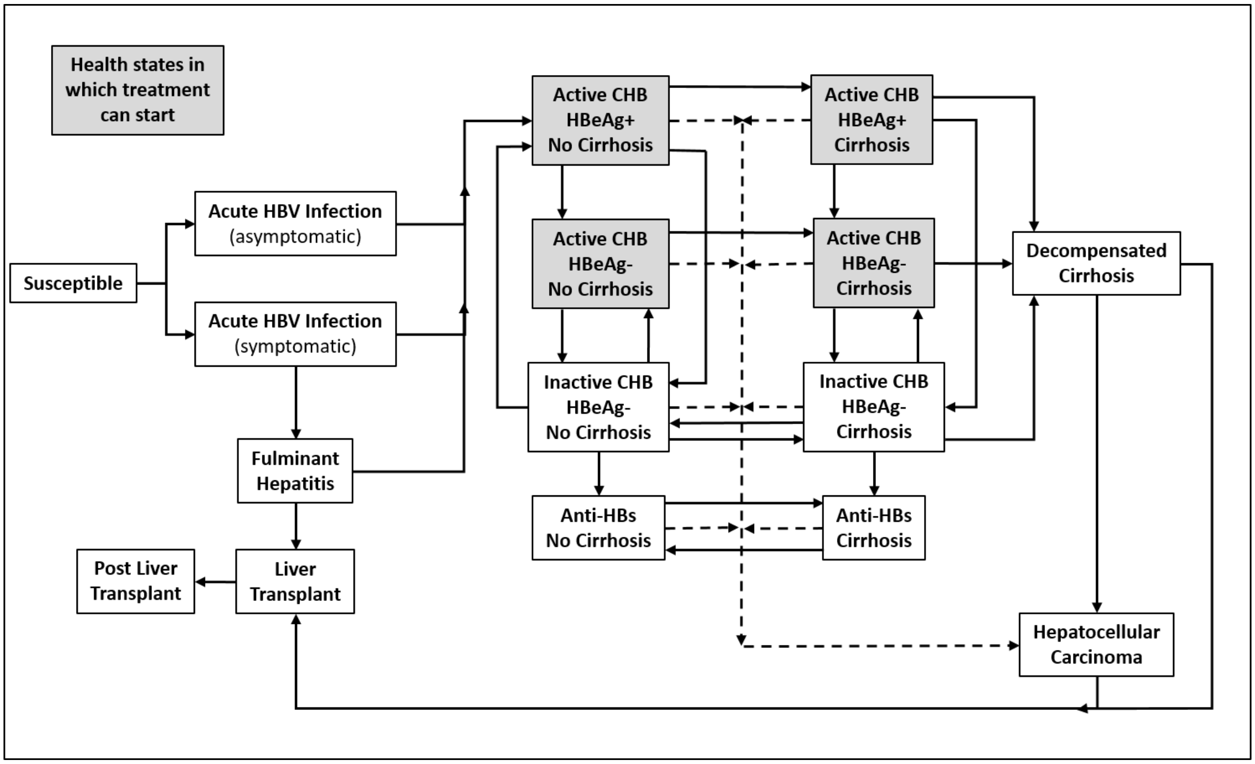
Appendix C: Supplemental Material for Chapter 4

Appendix C1. Description of Susceptible to Infection/Currently Infected Markov Processes

All trials that were not seroprotected entered the Susceptible to Infection Markov process, which was adapted from a previously published model[173] (Supplemental Figure 2). Each time step was one year and every health state included age-specific background mortality defined by the National Vital Statistics System (NVSS) 2015 U.S. Life Tables.[172]

All trials that represented a current, prevalent chronic HBV infection entered this Markov process in the "Active CHB, HBeAg+, No Cirrhosis" health state. All trials that entered the Susceptible to Infection Markov process started in the "Susceptible" health state and remained in that state until death or an incident acute HBV infection. The risk of acute HBV infection, which differed by risk group and age group, represented the risk of HBV infection among unvaccinated, uninfected U.S. adults and is further described in Appendix C2.

Supplemental Figure 2. Susceptible to infection Markov process diagram



Abbreviations: HBV, hepatitis B virus; CHB, chronic hepatitis B infection; HBeAg+, hepatitis B e-antigen positive; HBeAg-, hepatitis B e-antigen negative; anti-HBs, hepatitis B surface antibody. All health states can transition to death, either by background mortality or hepatitis B-related death.

Individual trials that acquired an acute HBV infection progressed through various stages of disease. Transition rates specific to each health state reflected the annual probability of transitioning from the current health state to the indicated target health state within each time step (Supplemental Table 5). Infected individuals followed the natural history of disease progression outlined by Chahal et al., unless they developed a chronic infection and began treatment.[173] Chahal el al. identified transition rates from a variety of primary and economic analyses of hepatitis B and converted all transition rates to annual transition probabilities.

Supplemental Table 5. Annual Markov transition rates for hepatitis B infection

Original Health State	Target Health State	Base Case	Lower	Upper	Reference
Acute HBV Infection	Active CHB	0.082	0.062	0.103	207
Acute HBV Infection (symptomatic)	Fulminant hepatitis	0.040	0.030	0.050	173
Fulminant hepatitis	Active CHB	0.071	0.053	0.089	173
Fulminant hepatitis	Liver transplant	0.017	0.017	0.045	173
Active CHB, non-cirr	HCC	0.005	0.002	0.007	173
Active CHB, cirr	HCC	0.024	0.002	0.081	173
Active CHB, cirr	DCC	0.050	0.023	0.095	173
HBeAg-, active CHB, cirr/non-cirr	Inactive CHB, cirr/non-cirr	0.016	0.000	0.110	173
HBeAg-, active CHB, non-cirr	HBeAg-, active CHB, cirr	0.046	0.005	0.150	173
HBeAg+, active CHB, cirr/non-cirr	HBeAg-, active CHB, cirr/non-cirr	0.019	0.010	0.038	173
HBeAg+, active CHB, cirr/non-cirr	Inactive CHB, cirr/non-cirr	0.095	0.071	0.119	173
HBeAg+, active CHB, non-cirr	HBeAg+, active CHB, cirr	0.024	0.007	0.038	173
Inactive CHB, cirr	HBeAg-, active CHB, cirr	0.007	0.005	0.009	173
Inactive CHB, non-cirr	HBeAg-, active CHB, non-cirr	0.016	0.012	0.020	173
Inactive CHB, non-cirr	HBeAg+, active CHB, non-cirr	0.002	0.002	0.003	173
Inactive CHB, non-cirr	Inactive CHB, cirr	0.005	0.004	0.007	173
Inactive CHB, non-cirr	HCC	0.001	0.001	0.001	173
Inactive CHB, cirr	HCC	0.011	0.009	0.014	173
Inactive CHB, cirr	Inactive CHB, non-cirr	0.000	0.000	0.005	173
Inactive CHB, cirr	DCC	0.000	0.000	0.001	173
Inactive CHB, cirr/non-cirr	anti-HBs, cirr/non-cirr	0.012	0.009	0.014	208
DCC	HCC	0.063	0.030	0.070	173
HCC or DCC	Liver transplant	0.017	0.017	0.045	173
anti-HBs, non-cirr	anti-HBs, cirr	0.000	0.000	0.005	173
anti-HBs, cirr	anti-HBs, non-cirr	0.000	0.000	0.005	173
anti-HBs	HCC	0.007	0.005	0.009	173
On Treatment					
HBeAg-, active CHB, cirr/non-cirr	Inactive CHB, cirr/non-cirr	0.760	0.380	0.850	173
HBeAg+, active CHB, cirr/non-cirr	Inactive CHB, cirr/non-cirr	0.210	0.105	0.315	173
Inactive CHB, cirr/non-cirr	anti-HBs, cirr/non-cirr	0.018	0.009	0.027	173

Abbreviations: HBV, hepatitis B virus; CHB, chronic hepatitis B infection; non-cirr, non-cirrhotic; cirr, cirrhotic; HCC, hepatocellular carcinoma; DCC, decompensated cirrhosis; HBeAg+, hepatitis B e-antigen positive; HBeAg-, hepatitis B e-antigen negative; anti-HBs, hepatitis B surface antibody.

As is commonly done in models of hepatitis B infection progression, the annual transition rate from an acute HBV infection to a chronic HBV (CHB) infection was the same for symptomatic and asymptomatic acute HBV infections.[173] However, only a symptomatic acute HBV infection could transition to fulminant hepatitis. Within one year, all individuals with an acute HBV infection either spontaneously cleared their infection and transitioned to the hepatitis B surface antibody (anti-HBs) positivity state in which they were no longer at risk for further HBV infection, or transitioned into an active CHB infection. For chronic infections, we modeled progression through combinations of immune active/immune inactive, e-antigen-positivity (HBeAg) and cirrhosis. Individuals could develop hepatocellular carcinoma from any chronic infection state. Additionally, individuals who underwent a liver transplant were assumed to not have a reoccurrence of hepatitis B infection.

Individuals with an immune active chronic infection were eligible to start treatment. Using data from the chronic hepatitis B care cascade[94], we calculated the cumulative proportion of CHB cases that are eligible for treatment to be 4.5%. The annual probability of initiating treatment was calculated using a assumed time period of 8 years and a formulaic relationship between rate and cumulative proportion[209]:

$$rate = \left(-\frac{1}{time}\right) \times \ln(1 - cumulative\ proportion)$$

Treatment increased the annual transition rates from immune active to immune inactive, which increased transition probability to clearance of infection. The effects of treatment on these transitions were assumed to be constant over time. Additionally, treatment could potentially lead to suppressed DNA levels of hepatitis B virus, which reduced the risk of progression to cirrhosis, decompensated cirrhosis, hepatocellular carcinoma and death (Supplemental Table 6). The probability of treatment resulting in viral suppression differed by HBeAg status and year of treatment. For the first year of treatment, 93% of HBeAg- and 76% of HBeAg+ individuals on treatment experienced viral suppression. If individuals did not experience viral suppression in the first year, the probability of viral suppression was reduced to 62.99% of the probability from the first year. The reduced risk of developing advanced liver disease conditions for participants that achieved viral suppression is summarized in Supplemental Table 6.

Supplemental Table 6. Markov inputs for hepatitis B treatment eligibility and effects

Treatment eligibility	**Base Case**	**Lower**	**Upper**	**Reference**
Proportion of acute HBV infections with symptoms	0.300	0.200	0.400	[173]
Proportion of CHB with a diagnosis	0.300	0.200	0.400	[94]
Proportion of diagnoses in care	0.500	0.400	0.660	[94]
Proportion of in care eligible for treatment	0.300	0.150	0.500	[94]
Proportion of CHB eligible for treatment	0.045	0.012	0.132	Calculated
Annual rate of discontinuing treatment	0.035	0.018	0.053	[173]
Treatment effects	**Base Case**	**Lower**	**Upper**	**Reference**
Proportion virally suppressed with treatment (HBeAg-)	0.930	0.700	1.000	[173]
Proportion virally suppressed with treatment (HBeAg+)	0.760	0.570	0.950	[173]
Risk reduction in progression to cirrhosis	0.550	n/a	n/a	[173]
Risk reduction in progression to DCC	0.450	n/a	n/a	[173]
Risk reduction in progression to HCC (non-cirrhotic)	0.521	n/a	n/a	[173]
Risk reduction in progression to HCC (cirrhotic)	0.540	n/a	n/a	[173]
Risk reduction in CHB related mortality (non-cirrhotic)	0.170	n/a	n/a	[173]
Risk reduction in CHB related mortality (cirrhotic)	0.680	n/a	n/a	[173]

Abbreviations: HBV, hepatitis B virus; CHB, chronic hepatitis B infection; HCC, hepatocellular carcinoma; DCC, decompensated cirrhosis; HBeAg+, hepatitis B e-antigen positive; HBeAg-, hepatitis B e-antigen negative.

All health stages included background mortality identical to the Healthy Life Markov process for trials protected against infection. The background mortality rates were defined by single-year of age annual mortality rates from the National Vital Statistics System (NVSS) 2015 U.S. Life Tables.[172] Additionally, several health states had increased mortality rates due to a chronic HBV infection and sequelae (Supplemental Table 7).

Supplemental Table 7. Annual risk of mortality related to HBV infection, by health state

Health State	**Base Case**	**Lower**	**Upper**	**Reference**
Background mortality	Differs by single-year of age			172
Fulminant hepatitis	0.670	0.503	0.838	173
Active CHB, non-cirrhotic	0.010	0.003	0.028	173
Active CHB, cirrhotic	0.030	0.013	0.048	173
Inactive CHB	0.007	0.004	0.009	173
Decompensated Cirrhosis	0.129	0.103	0.155	173
Hepatocellular Carcinoma	0.427	0.342	0.512	173
Liver transplant	0.107	0.090	0.130	173
Post-transplant	0.049	0.039	0.059	173
anti-HBs	0.000	0.000	0.009	173

Abbreviations: HBV, hepatitis B virus; CHB, chronic hepatitis B infection; anti-HBs, hepatitis B surface antibody.

Appendix C2. Risk of Acute HBV Infection Calculation

The risk of infection parameter represented the annual risk of acute HBV infection among unvaccinated, uninfected adults. Individuals who acquired vaccine-induced protection and were no longer at risk of infection entered a "Healthy Life" Markov process in which their risk of infection was zero. Therefore, the estimated risk of infection described below was only applied to persons who were susceptible to a new infection.

Reported incidence rates of acute HBV infection from the 2017 Division of Viral Hepatitis Surveillance Report represented incident acute HBV infections among all adults within a specific age group.[1] Due to a lack of symptoms in many acute HBV infections and a lack of resources allocated to health departments that conduct investigations to ascertain new infections, many acute infections are not reported.[19] We adjusted the reported incidence rates for this underreporting factor, current levels of vaccination and current HBV prevalence to estimate the parameters needed for this model (i.e. risk of infection among unvaccinated, uninfected adults) (Supplemental Table 9, Supplemental Figure 3).

First, the reported acute HBV incidence was scaled by an underreporting multiplier that was previously estimated.[19] Second, we further adjusted the estimate to account for the removal of persons that were already infected or vaccinated. The most recent data on current HBV prevalence was from an analysis of 2007-2012 National Health and Nutrition Examination Survey (NHANES), which estimated the prevalence of antibody to hepatitis B core antigen (anti-HBc) among different age groups.[35] NHANES is a large, national survey representative of the U.S. noninstitutionalized population. Estimates of current vaccine coverage and efficacy were from sources described in the methods section of the main paper.

Finally, data from case reports of incident infections in 2015 were used to stratify the estimated risk of infection inputs by risk group. In 2015, 47.8% of new infections with risk factor data reported at least one risk factor.[56] This was divided by the proportion of the population that was high-risk (30%)[163] to create an adjustment factor that was multiplied by the overall risk of infection estimates. The complementary probabilities were used to calculate the adjustment factor for estimating risk of infection among non-high risk persons.

Supplemental Table 8. Inputs and formula for calculating risk of infection among unvaccinated, uninfected adults

							Estimated Incidence Rate (per 100,000)	
Age Group (years)	**Acute HBV Incidence (per 100,000)[1]**	**Under-reporting Multiplier[19]**	**Acute HBV Prevalence[35]**	**3-dose Coverage [61,175]**	**2-dose Coverage**	**1-dose Coverage**	**Non-high risk**	**High-risk**
19-29	0.60	6.48	0.033	0.913	0.028	0.029	46.36	99.05
30-39	2.32	6.48	0.033	0.329	0.082	0.091	19.86	42.44
40-49	2.54	6.48	0.033	0.329	0.082	0.091	21.75	46.47
50-59	1.62	6.48	0.067	0.159	0.122	0.107	11.54	24.66
60+	0.56	6.48	0.067	0.159	0.129	0.106	3.90	8.34

Supplemental Figure 3. Calculation for risk of infection among unvaccinated, uninfected adults in high-risk group

$$Inc.Rate = \frac{reported\ incidence * underreporting\ multiplier}{1-(p)-(\sum_{dose=1}^{dose=3}(vax_{dose} * eff_{dose}))+((\sum_{dose=1}^{dose=3} p * vax_{dose} * eff_{dose}))} \times \frac{pInfHR}{pPopHR}$$

Where p=prevalence; vax=vaccine coverage; eff=efficacy; pInfHR=proportion of infections that are among high-risk persons and pPopHR=proportion of population that is high-risk.

All inputs for calculating risk of infection were included in sensitivity analyses. The lower and upper bounds of reported acute HBV incidence were set at 50% and 200% of the reported values (Supplemental Table 9).

Supplemental Table 9. Base case values and ranges for inputs used in calculating risk of infection among unvaccinated, uninfected adults

Input	Base Case	Lower	Upper	Reference
Reported Acute HBV Incidence (per 100,000)				
19-29 years	0.60	0.30	1.20	1
30-39 years	2.32	1.16	4.64	1
40-49 years	2.54	1.26	5.08	1
50-59 years	1.62	0.81	3.24	1
60+ years	0.56	0.28	1.12	1
Under-reporting multiplier	6.48	3.24	9.72	**19**
Acute HBV Prevalence				
19-29 years	0.033	0.028	0.038	**35**
30-39 years	0.033	0.028	0.038	**35**
40-49 years	0.033	0.028	0.038	**35**
50-59 years	0.067	0.058	0.077	**35**
60+ years	0.067	0.058	0.077	**35**
Proportion of incident infections among high-risk	0.478	0.359	0.598	56
Proportion of the population that is high risk	0.300	0.150	0.450	163

Abbreviations: HBV, hepatitis B virus.

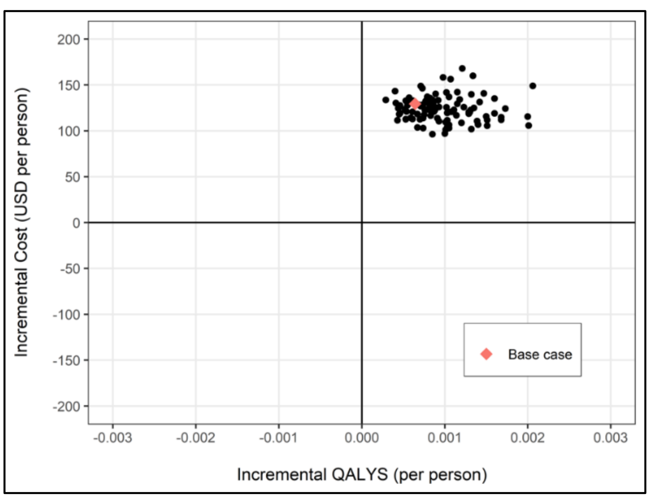
Appendix C3. Supplemental Results

Supplemental Table 10. Population-level intermediate outcomes for base case scenario

	Baseline Strategy		50% Coverage (Base Case)		
Intermediate Outcome	**Non-high Risk**	**Total**	**Non-high Risk**	**Total**	**% Change (Total)**
U.S. Adult Population	173,495,380	247,822,574	173,495,380	247,822,574	
Person-years	5,676,327,980	8,094,785,111	5,676,604,302	8,095,061,433	
Incident Health Outcomes					
Acute HBV infections	369,256	621,291	226,510	478,545	-23.0
Asymptomatic	263,683	440,133	158,111	334,560	-24.0
Symptomatic	105,572	181,158	68,399	143,985	-20.5
Fulminant hepatitis	4,709	6,939	3,222	5,452	-21.4
Chronic HBV infections	29,243	51,795	16,852	39,404	-23.9
Hepatocellular carcinoma	49,812	82,029	30,234	62,451	-23.9
Liver transplants	1,983	2,974	991	1,983	-33.3
HBA-related deaths	51,547	86,242	31,969	66,664	-22.7
Vaccination					
Number of vaccine doses	96,020,343	175,945,354	271,599,167	351,524,178	99.8
Trials protected	32,006,781	58,648,451	84,428,938	111,070,608	89.4

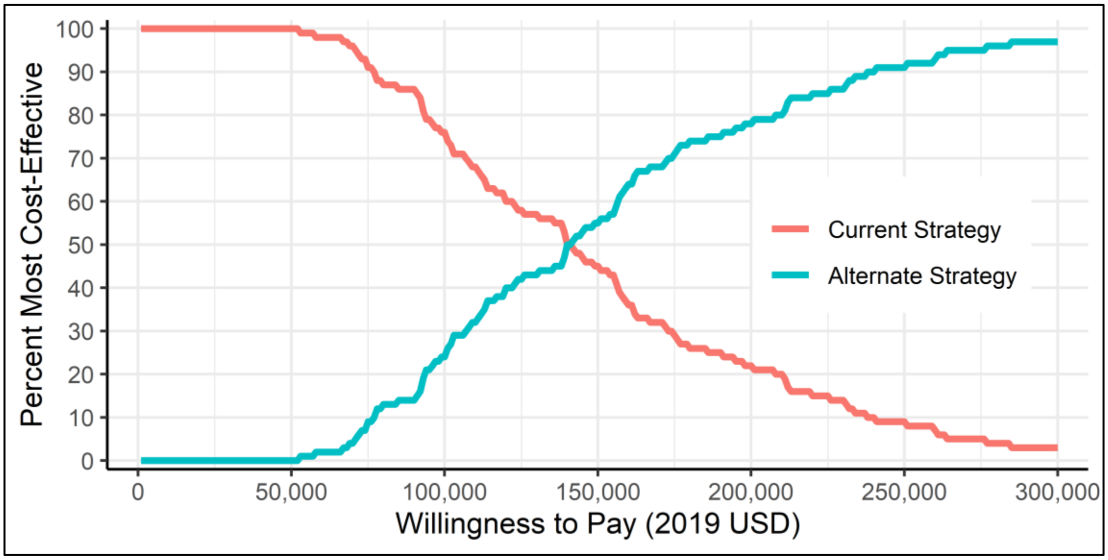
*Based on model run with 1,000,000 microsimulations. Assumes the intervention strategy does not result in any additional vaccination among high risk persons.

Supplemental Figure 4. Scatter plot of incremental cost and incremental quality-adjusted life years from a probabilistic sensitivity analysis of all input parameters



Abbreviations: USD, U.S. Dollars; QALYS, quality-adjusted life years.
Note: Each of the 100 parameter sets was run with 1,000,000 microsimulations. All analyses compare current vaccination coverage to 50% vaccination coverage among the general population and no additional vaccination coverage among high-risk persons. All analyses assume the cost of one vaccine dose is $58.95.

Supplemental Figure 5. Cost-effectiveness acceptability curve of probabilistic sensitivity analysis of all inputs



Note: Each of the 100 parameter sets was run with 1,000,000 microsimulations. All analyses compare current vaccination coverage to 50% vaccination coverage among the general population and no additional vaccination coverage among high-risk persons. All analyses assume the cost of one vaccine dose is $58.95.

Supplemental Table 11. Results of one-way interval sensitivity analysis on vaccine coverage among non-high risk persons in a cost-utility analysis of universal vaccination against HBV infection among general population adults, United States.

	Vaccine Coverage				
	30%	**40%**	**Base Case 50%**	**60%**	**70%**
USD per person (baseline strategy)	670.12	670.12	670.12	670.12	670.12
USD per person (intervention)	747.51	773.28	799.63	824.55	850.69
Incremental USD per person	77.40	103.16	129.51	154.43	180.57
Incremental QALYs per person	0.0004	0.0006	0.0006	0.0009	0.0011
ICER (USD/QALY)	209,641	182,159	201,780	167,403	169,998
% Acute HBV infections averted	13.8	18.7	23.0	28.0	33.1
USD per acute HBV infection averted	223,687	219,484	224,847	220,303	217,292
NNV (acute infection)	368	361	368	363	357
% HBV deaths averted	13.8	18.7	22.7	30.5	35.9
USD per HBV death averted	1,612,409	1,587,039	1,639,392	1,456,910	1,444,560
Incremental life-years per person	0.0007	0.0010	0.0011	0.0016	0.0019
USD per life-year gained	117,089	102,644	116,154	96,400	95,540

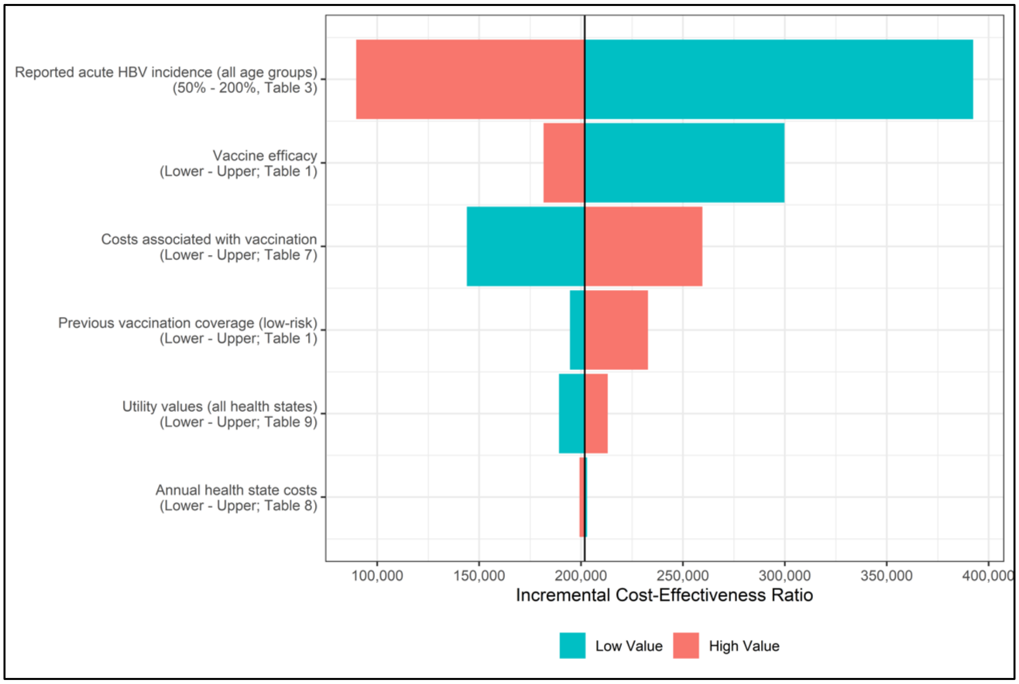
Abbreviations: HBV, hepatitis B virus; USD, 2019 U.S. Dollars; QALYs, quality-adjusted life years; ICER, incremental cost-effectiveness ratio; NNV, number needed to vaccinate to prevent an acute infection; %, percent.
Note: Scenarios assume coverage in the youngest group (19-29 years) does not decrease below current coverage (91.3%). Intervention strategies in all scenarios assume no additional vaccination among high-risk persons. 1,000,000 microsimulations per scenario.

Supplemental Table 12. Results of one-way interval sensitivity analysis on increased vaccine coverage among high risk persons in a cost-utility analysis of universal vaccination against HBV infection among general population adults, United States

	Additional Vaccination Among High-Risk*				
	Base Case 0%	**20%**	**40%**	**60%**	**80%**
USD per person, baseline	670.12	670.12	670.12	670.12	670.12
USD per person, intervention	799.63	816.39	832.97	849.16	865.72
Incremental USD per person	129.51	146.27	162.85	179.04	195.60
Incremental QALYs per person	0.0006	0.0009	0.0010	0.0012	0.0014
ICER (USD/QALY)	201,780	169,713	158,142	145,132	139,870
% Acute HBV infections averted	23.0	29.4	34.9	40.9	47.9
USD per acute HBV infection averted	224,847	198,194	186,323	174,499	163,001
NNV (acute infection)	368	324	304	285	267
% HBV deaths averted	22.7	30.2	35.9	42.8	48.0
USD per HBV death averted	1,639,392	1,393,024	1,302,767	1,201,585	1,171,264
Incremental life-years per person	0.0011	0.0015	0.0018	0.0021	0.0024
USD per life-year gained	116,154	98,896	92,579	83,545	80,894

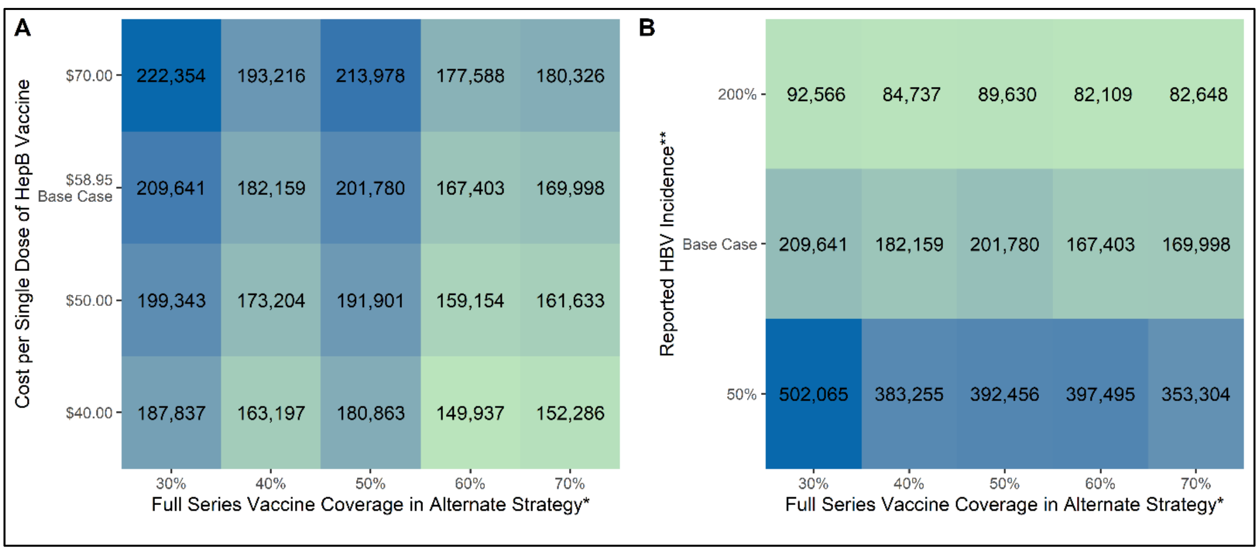
Abbreviations: HBV, hepatitis B virus; USD, 2019 U.S. Dollars; QALYs, quality-adjusted life years; ICER, incremental cost-effectiveness ratio; NNV, number needed to vaccinate to prevent an acute infection; %, percent.
Note: Baseline strategy includes vaccine coverage of 91.3% (19-29 years), 32.9% (30-49 years), and 15.9% (50+ years) among high-risk persons. Intervention strategies in all scenarios assume 50% vaccination coverage among non-high risk persons. 1,000,000 microsimulations per scenario.

Supplemental Figure 6. Tornado diagram of group inputs



Abbreviations: HBV, hepatitis B virus.
*All inputs within each group were concurrently varied in the same direction.

Supplemental Figure 7. Heat maps of incremental cost-effectiveness ratios from two-way sensitivity analyses



Abbreviations: HBV, hepatitis B virus; HepB, hepatitis B vaccine; QALYs, quality-adjusted life years;%, percent.
Note: Intervention strategies assume no additional vaccination among high-risk persons. 1,000,000 microsimulations.