Southwest Rural HEALTH RESEARCH CENTER

The Co-occurrence of HIV and Opioid Mortality in Rural and Urban America from 1999-2018

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Purpose

This policy brief evaluates trends in mortality from Human Immunodeficiency Virus (HIV) and opioid use in rural and urban areas of the U.S. Specifically, it uses data from the Centers for Disease Control and Prevention (CDC) Wide-ranging Online Data for Epidemiology Research (WONDER) mortality database from 1999 to 2018 to explore whether HIV and opioid deaths appear to be related over time in rural and urban areas.

Background

In 2014, the small community of Austin, Indiana – with a population of less than 4,500 – made national headlines for one of the worst HIV outbreaks in recent U.S. history.[1] More than 200 residents in the rural Scott County community were diagnosed with HIV during a time when the sharing of needles was noted and the opioid epidemic was growing.[2] This alarming HIV outbreak, coupled with the massive scope of the opioid epidemic in the U.S. led many public health professionals, health care providers, and other stakeholders to fear that this phenomenon would become national in scope. By 2016, injecting opioids was linked to 13 percent of new HIV diagnoses as well as additional HIV outbreaks in Lawrence and Lowell Massachusetts.[3] Previous research has suggested that certain communities could be at high risk of HIV outbreaks in light of the opioid epidemic. Specifically, the CDC has identified 220 counties that they believe to be at risk for rapid dissemination of HIV and Hepatitis C in light of the opioid epidemic.[4-6]

Prior research evaluating the possible association between opioid use and HIV suggests that some Americans are at higher risk of contracting HIV through opioid use than others. For example, some studies have shown that young abusers (ages 18-24) of prescription opioids are more likely to use alternative routes of administration such as injection and to re-use non-sterile needles, putting them at higher risk of HIV infection.[7] Similarly, White and Hispanic individuals have been found to have higher odds of using intravenous (IV) injection as a mode or route for medication abuse as compared to Blacks.[7] With injection drug use linked to up to 72 percent of hospital admissions in HIV/AIDS wards, opioid injection poses considerable risk for contracting HIV and could lead to higher mortality.[8]

Key Findings

- We find no positive relationship between opioid mortality and HIV mortality. Instead, from 1999 to 2018, HIV mortality rates in the United States declined while opioid mortality rates increased.
- Across our period of analysis, HIV mortality rates remained lower in rural noncore areas compared to metropolitan areas.
- Across categories of race/ethnicity, sex, and census regions, the highest rates of HIV mortality occurred in large central metropolitan areas. However, these areas made considerable progress in reducing HIV mortality over the past two decades.
- From 1999 to 2018, opioid mortality rose steadily across all levels of rurality, with the highest mortality rates occurring among men, Whites, and individuals living in the Northeast and Midwest census regions.
- Even though rural opioid mortality rates were lower than those of urban areas during most of the study period, the most drastic increases in opioid-related mortality occurred in micropolitan, noncore, and small metropolitan areas.

Existing research also suggests that rural communities may be at particular risk for opioid use and HIV infection due to a number of factors. Injection drug use has been found to contribute to new HIV diagnoses at higher rates in rural settings than in urban settings.[2] In addition, rural individuals are more likely to inject both prescription and non-prescription opioids.[9-10] Critically, HIV infection in rural areas appears to be related to worse health outcomes. Rural individuals with HIV are more likely to begin care with more advanced disease states, more likely to progress to acquired immunodeficiency syndrome (AIDS) within one year of diagnosis, and have higher mortality compared to urban individuals.[2;11]

Despite significant research exploring potential linkages in the relationship between HIV and opioids, significant questions remain. Most importantly, how has mortality from HIV and opioids changed over time in rural and urban areas? The results presented in this policy brief answer this question by studying mortality rates from opioids and HIV over an extended period of time in rural and urban areas of the U.S.

Methods

To study trends in opioid- and HIV-related mortality over time in rural and urban areas, this policy brief relies on mortality data (1999-2018) obtained through the CDC WONDER database.[12] This database captures cause of death data from death certificates of U.S. residents and includes both the primary underlying cause of death and up to 20 additional (multiple) causes of death. Opioid overdose deaths were defined as those with an underlying cause of death related to poisoning, (International Statistical Classification of Diseases, 10th Revision [ICD-10] codes X40-X44, X60-64, X85, and Y10-Y14) and a multiple cause of death code related to an opioid (ICD-10 codes T40.0-T40.4 and T40.6). HIV-related deaths were defined as those for which the underlying cause was determined to be HIV infection, as indicated by ICD-10 codes B20-B24. Notably, codes B20-24 include individuals with AIDS, the most severe phase of HIV infection.[19-21, †] Age-adjusted mortality rates per 100,000 population were generated by CDC WONDER using the 2000 U.S. standard population.[††]

We present trends in mortality rates across the rural-urban continuum using the 2013 National Center for Health Statistics (NCHS) Urban-Rural classification scheme for counties which, based on population, classifies all U.S. counties and county equivalents into one of the following six levels of rurality - large central metropolitan, large fringe metropolitan, medium metropolitan, small metropolitan, micropolitan, and noncore.[13] In this classification scheme, micropolitian and noncore areas are considered rural while the other four categories are considered urban. We merged mortality rates for noncore and micropolitan categories in cases where examining each category separately would have resulted in suppressed data due to low counts. In such cases, micropolitan and noncore categories were labeled as "non-metropolitan". We highlight differences in opioid and HIV-related mortality across these levels of rurality overall and by sex, race/ethnicity (Black, Hispanic, White), and census region (Northeast, Midwest, South, West). All figures depicting trends over time were generated using Stata Statistical Software, Release 16.

Statistical analysis

We examine the correlation between opioid and HIV mortality rates for each level of rurality. To compare trends in mortality across groups, we used the Joinpoint Regression Program to estimate the average annual percent changes (AAPCs) in opioid & HIV mortality rates from 1999 to 2018.[14] The AAPC is a summary measure of the trend over a fixed time period.[15] The AAPC is a single number used to describe the average rate of change over a period of multiple years.

† HIV progresses through three stages from acute HIV infection, to chronic HIV infection, to AIDS. AIDS is the most severe phase of HIV infection and individuals receive an "AIDS diagnosis when their CD4 cell count drops below 200 cells/mm, or if they develop certain opportunistic infections."[19]

†† We do not look at the combination of mortality from both causes of death in this analysis because the sample size from the combined causes of death was too small to be analyzed across levels of rurality due to data suppression issues.

Results

From 1999 to 2018, there were a total of 446,032 deaths related to opioid poisonings and 200,605 HIV-related deaths. **Figure 1** shows overall trends in age-adjusted mortality rates for HIV and opioid poisonings from 1999 to 2018. Deaths from opioid poisonings increased significantly over the study period, from 2.9 per 100,000 in 1999 to 14.6 per 100,000 in 2018, resulting in an average annual increase of 9.2 percent (AAPC=9.2, 95% CI=7.6, 10.8). Alternatively, HIV mortality rates significantly decreased over time, from 5.3 per 100,000 in 1999 to 1.5 per 100,000 in 2018, an average annual decrease of 6.3 percent (AAPC=-6.3, 95% CI=-6.9, -5.7).

Figure 2 presents trends in HIV and opioid mortality over time and across levels of rurality. While HIV mortality rates significantly declined across all rurality levels over the study period, opioid mortality rates steadily increased across all rurality levels for most of the study period, with rates only beginning to decline in 2018. Urban-rural differences in HIV mortality rates narrowed over time, whereas urban-rural differences in opioid mortality rates widened over the study period. HIV mortality rates were consistently highest in large central metropolitan areas and generally lowest in rural (micropolitan & noncore) areas over the study

Figure 1. Opioid & HIV Mortality in the United States, 1999-2018

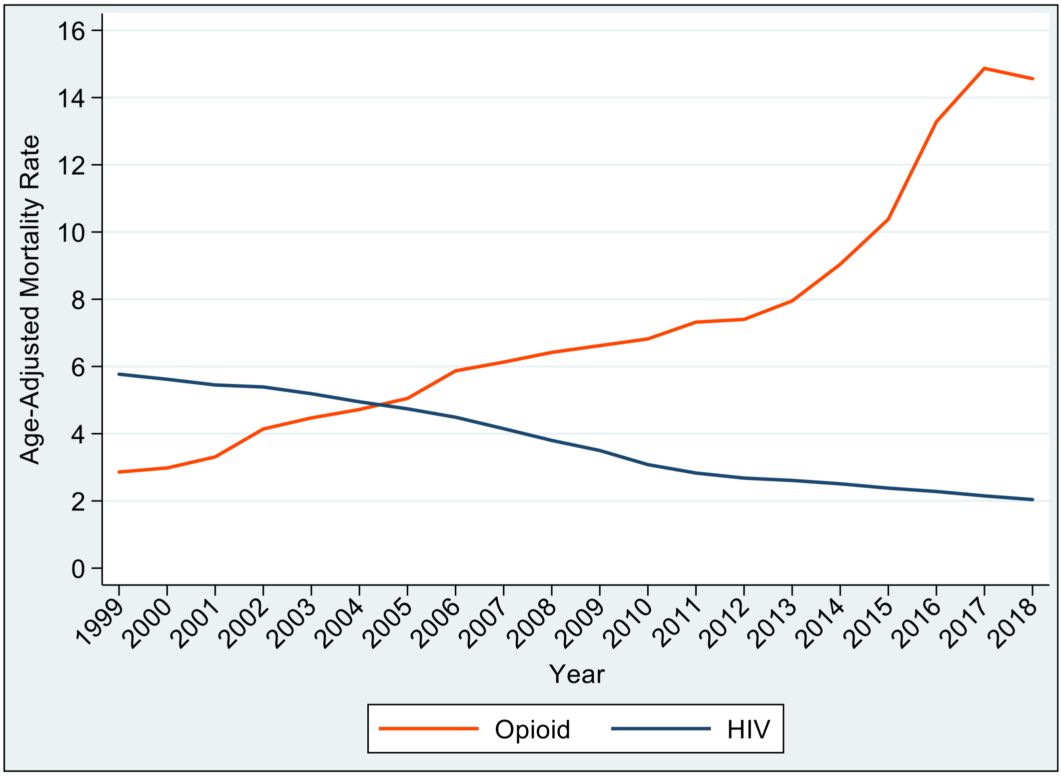
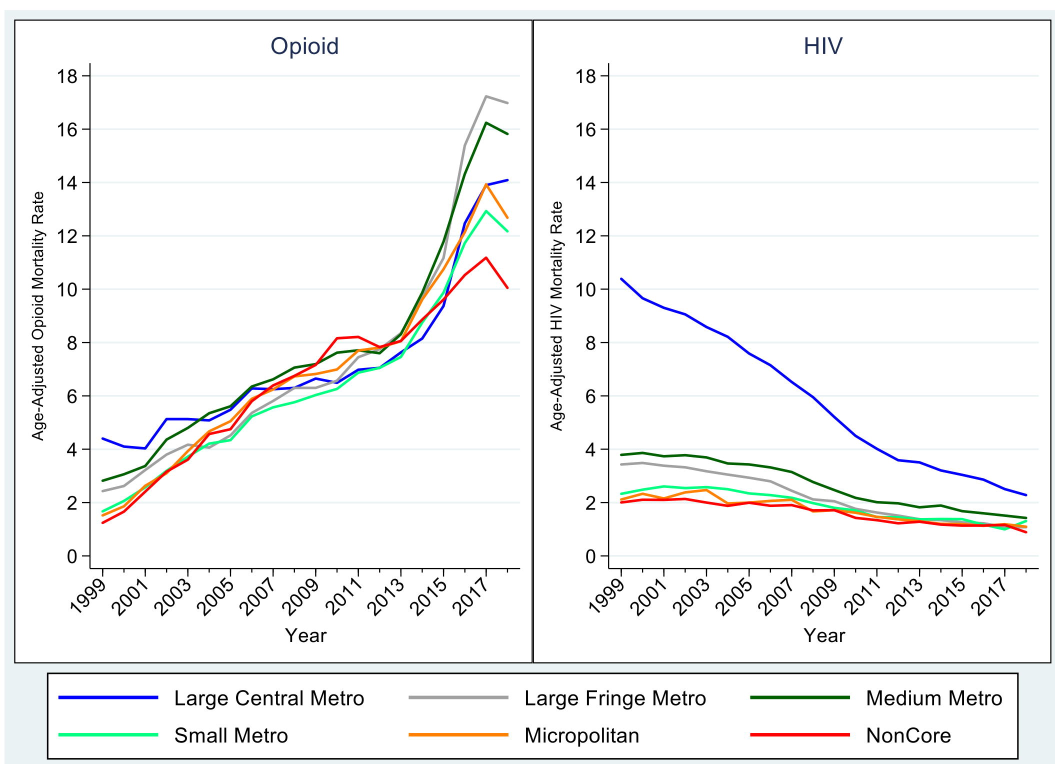


Figure 2. Opioid & HIV Mortality by Rurality, 1999-2018



period. Urban-rural trends in opioid mortality were less consistent, with the highest rates fluctuating between urban and rural areas depending on the year. The rate of change in opioid and HIV mortality rates also differed by rurality. For HIV, the largest decline in mortality rates occurred among large central metropolitan areas (AAPC -7.5, 95% CI=-8.5, -6.1), followed by large fringe metropolitan areas. For opioid mortality rates, the largest percent increases occurred in micropolitan areas (AAPC=11.6, 95% CI=10.1, 13.2), followed by small metropolitan and noncore areas.

Figure 3 presents urban-rural trends in opioid mortality by sex. Males had higher opioid mortality rates and greater variation across levels of rurality than their female counterparts. Opioid mortality rates increased significantly and across all rurality levels for both sexes from 1999 to 2018, with the greatest increases occurring among females living in micropolitan areas (AAPC=13.2, 95% CI= 11.0, 15.4), and the second greatest increases happening in noncore areas.

Figure 3. Opioid Mortality by Sex, 1999-2018

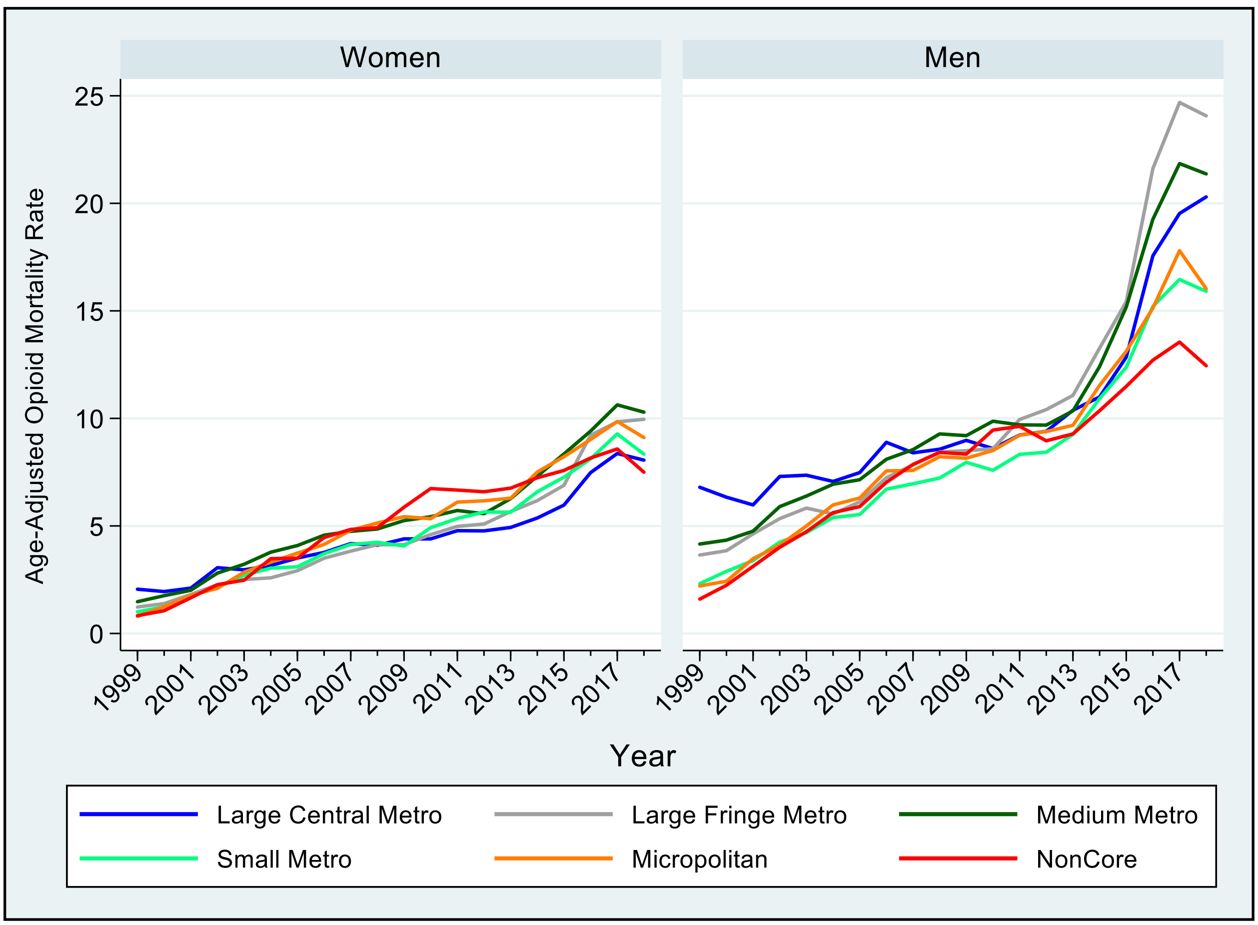
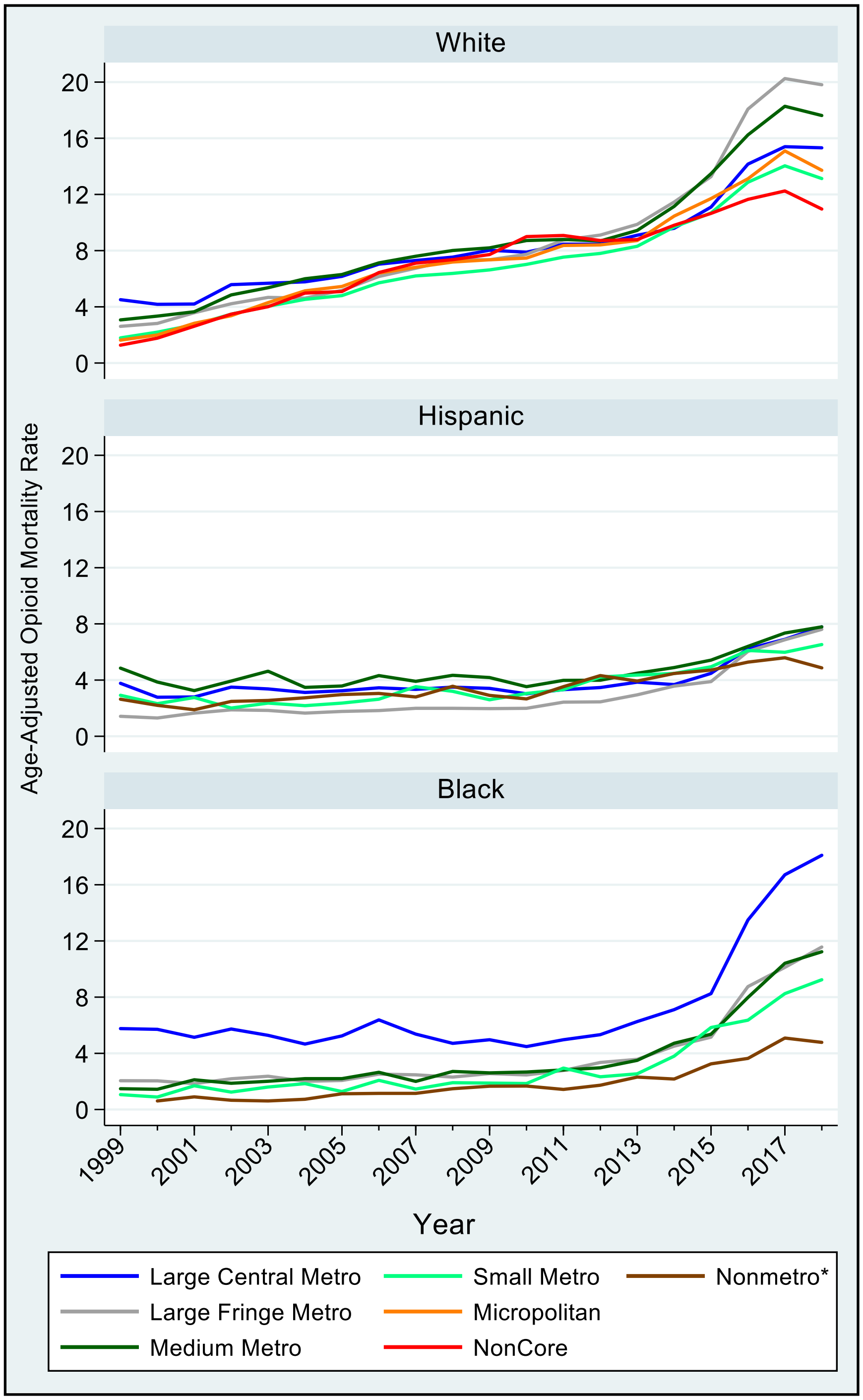


Figure 4 shows opioid mortality trends by race/ethnicity and across levels of rurality. In general, opioid mortality rates were highest among Whites, followed by Blacks, and lowest in Hispanics. While urban-rural disparities were largest among Blacks, opioid mortality rates increased across all racial/ethnic groups and levels of rurality, with the largest increases occurring among Blacks living in nonmetropolitan areas (AAPC=13.10, 95% CI=11.3, 14.8).

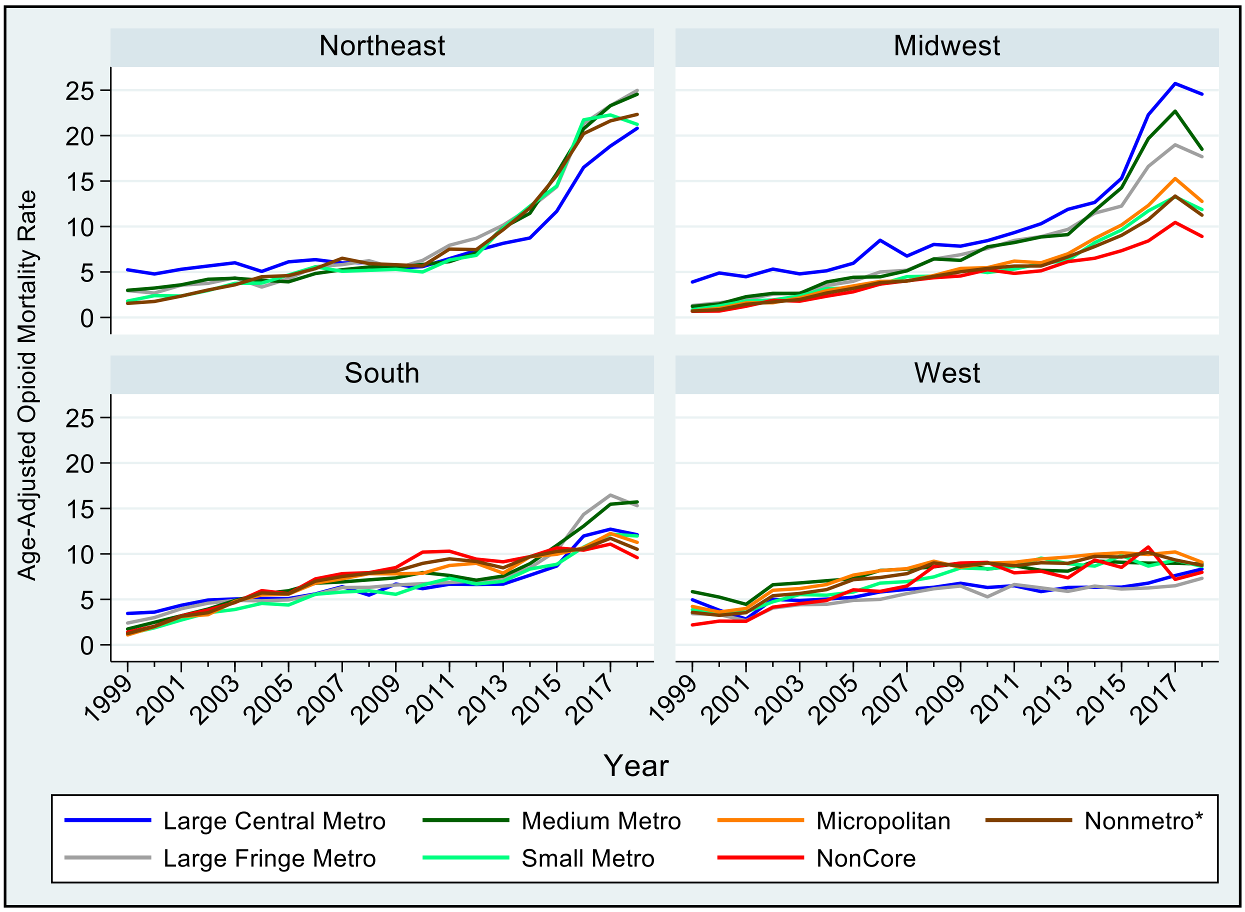
Figure 4. Opioid Mortality by Race/Ethnicity, 1999-2018



*Note: We combined mortality rates for noncore and micropolitan categories in cases where examining each category separately would have resulted in suppressed data due to low counts. In such cases, micropolitan and noncore categories were labeled as "nonmetro." In Figure 4, nonmetro is used in place of micropolitan and noncore categories for Hispanics and Blacks.

Figure 5 presents trends in opioid mortality across levels of rurality by census region. Overall, opioid mortality rates were highest in the Northeast and lowest in the West. Urban-rural differences in opioid mortality rates were most pronounced in the Midwest. From 1999 to 2018, opioid mortality rates increased faster in rural (noncore and micropolitan) areas than urban areas for all regions except for the South. Notably, the greatest increases in opioid mortality occurred in the Midwest, specifically within micropolitan areas – with an average annual increase of 16.5 percent per year from 1999 to 2018 (AAPC=16.5, 95% CI=11.6. 21.5).

Figure 5. Opioid Mortality by Census Region, 1999-2018



* Note: We combined mortality rates for noncore and micropolitan categories in cases where examining each category separately would have resulted in suppressed data due to low counts. In such cases, micropolitan and noncore categories were labeled as "nonmetro." In Figure 5, nonmetro is used in place of micropolitan and noncore categories for the Northeast.

Figure 6 presents urban-rural trends in HIV mortality by sex. Males had higher HIV mortality rates with greater variation across levels of rurality than females. Mortality rates decreased significantly across all levels of rurality for both males and females for HIV, with the largest declines occurring among males in large central metropolitan areas (AAPC=-7.6, 95% CI= -8.6, -6.6).

Figure 6. HIV Mortality by Sex, 1999-2018

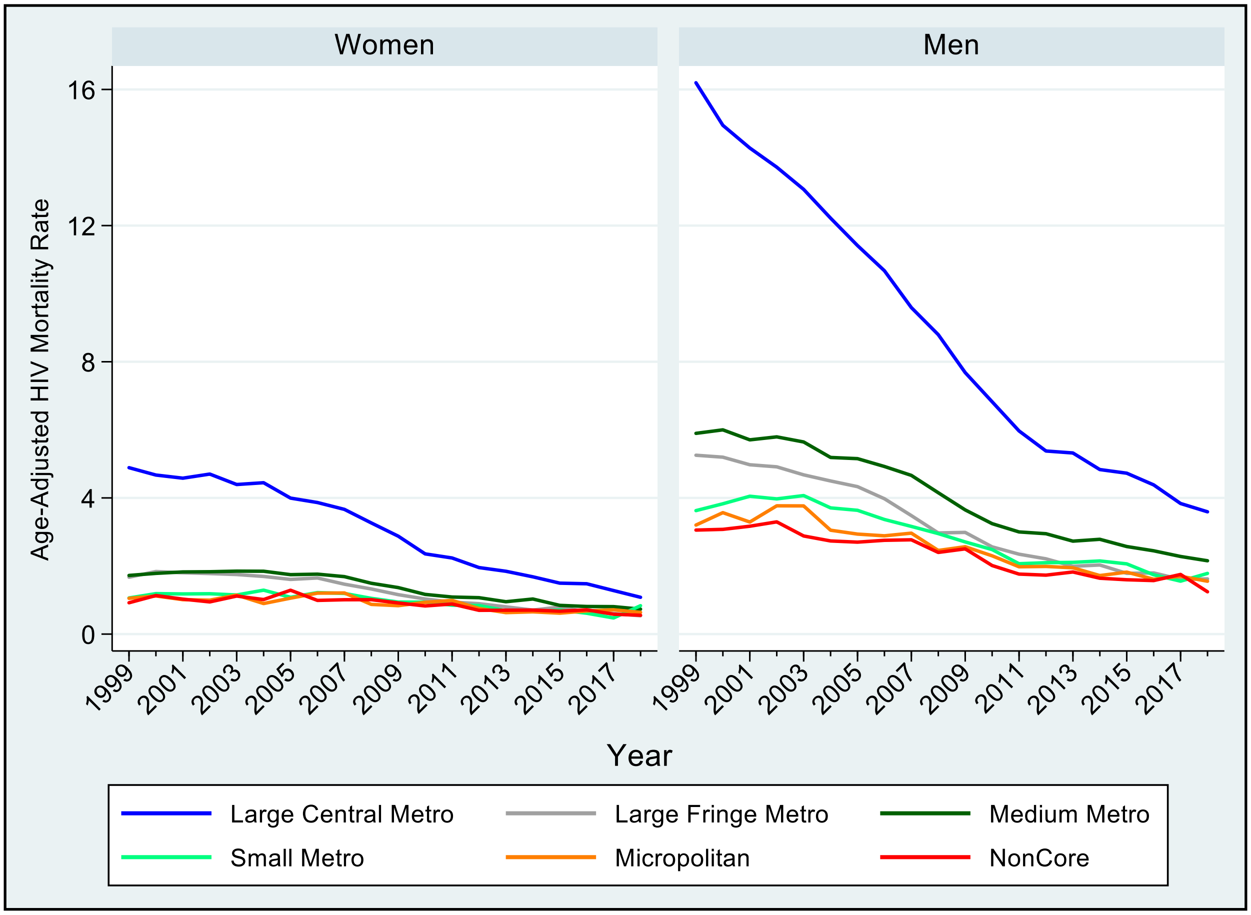
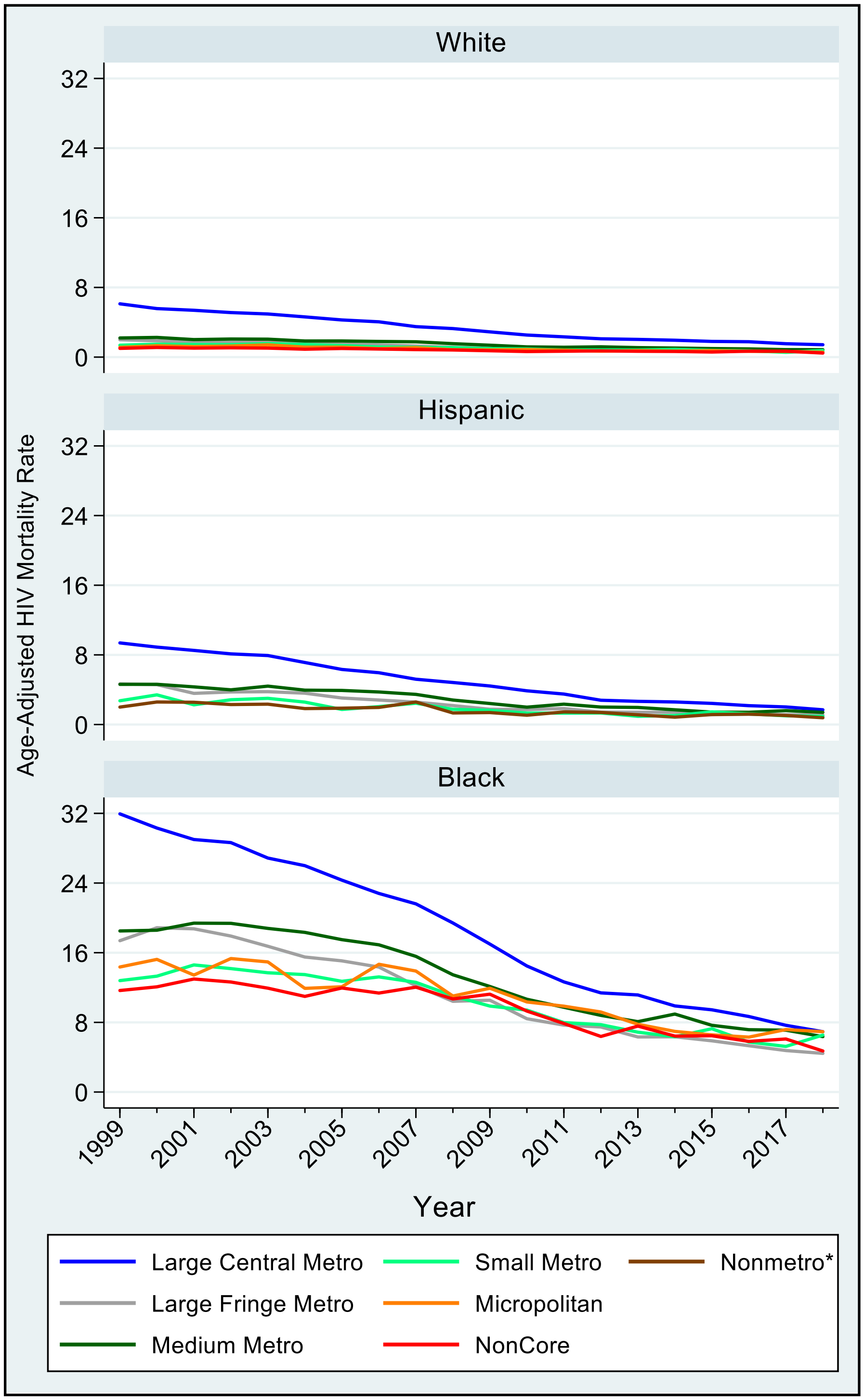


Figure 7 shows HIV mortality trends by race/ethnicity and across levels of rurality. HIV mortality rates were generally highest among Blacks, followed by Hispanics, and lowest among Whites. Mortality rates were highest in large central metropolitan areas for all race/ethnic groups, but urban-rural disparities were most striking among Blacks. Declines in HIV mortality occurred across all racial groups and rurality levels, with the greatest average annual decreases occurring among Hispanics residing in large central metropolitan areas (AAPC=-8.5, 95% CI=-9.1, -7.9).

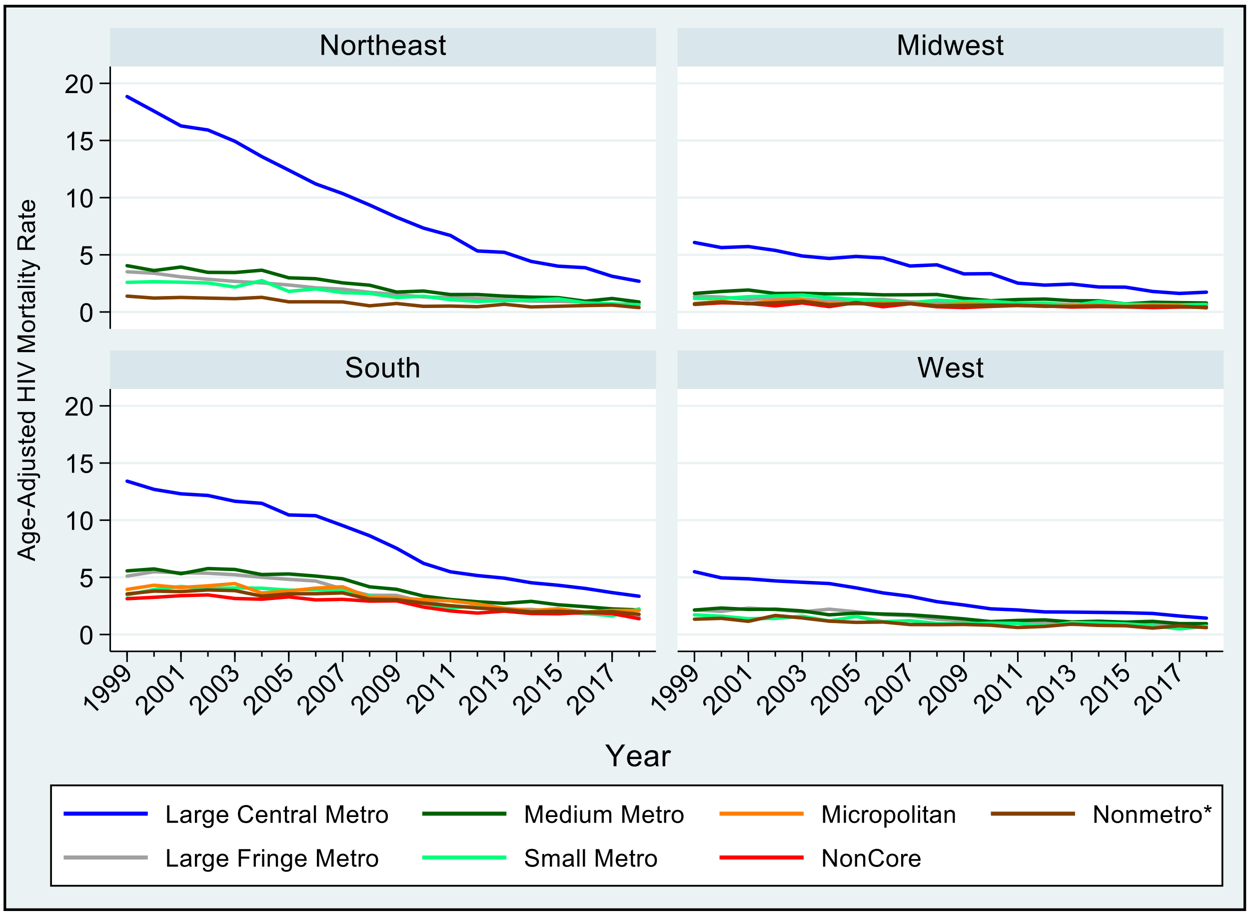
Figure 7. HIV Mortality by Race/Ethnicity, 1999-2018



*Note: We combined mortality rates for noncore and micropolitan categories in cases where examining each category separately would have resulted in suppressed data due to low counts. In such cases, micropolitan and noncore categories were labeled as "nonmetro." In Figure 7, nonmetro is used in place of micropolitan and noncore categories for Hispanics.

Figure 8 presents HIV mortality trends across levels of rurality by census region. In general, HIV mortality rates were highest in the South, and lowest in the West. Urban-rural gaps in HIV mortality rates were largest in the Northeast. HIV mortality rates decreased more in urban areas for all census regions, with the greatest annual declines occuring in large central metro areas of the Northeast (AAPC=-9.40, 95% CI=-9.9, -9.0).

Figure 8. HIV Mortality by Census Region, 1999-2018



* Note: We combined mortality rates for noncore and micropolitan categories in cases where examining each category separately would have resulted in suppressed data due to low counts. In such cases, micropolitan and noncore categories were labeled as “nonmetro.” In Figure 8 nonmetro is used in place of micropolitan and noncore categories for the Northeast and West census regions.

Discussion

By analyzing mortality data for opioids and HIV from 1999 to 2018, using the CDC WONDER mortality database, this policy brief provides important information about the possible relationship between the two outcomes over time across levels of rurality. Our results show a consistent decline in HIV mortality rates over time and a troubling rise in deaths from opioids across our period of analysis.

When analyzing HIV and opioid deaths across levels of rurality, it generally appears that rural areas have had lower mortality rates than their urban counterparts. For HIV, the noncore regions had the lowest mortality rate for most of the study period. For opioids, the noncore regions had the lowest mortality rate during the early years of the study period, switched to having the highest mortality rate in 2010 and 2011, and returned to having the lowest mortality rate by the end of the study period. Large central metropolitan areas are of particular note when studying HIV. Residents in these areas experienced considerably higher mortality rates at the start of the study period and have made substantial progress in reducing that mortality rate over the past two decades – driven in large part by declining mortality for HIV among Blacks and men in large central metropolitan areas. Notably, however, HIV mortality in large central metropolitan areas is still higher than for any other level of urbanization.

Other differences across levels of rurality stand out as well. For example, when analyzing differences across levels of rurality by race, we see that opioid mortality rates are highest for Whites in large fringe metropolitan areas and medium metropolitan areas, but highest for Blacks in large central metropolitan areas. In contrast, when studying HIV mortality by race, we can see that for all races/ethnicities studied rates were highest in large central metropolitan areas, with the greatest decreases in mortality seen across all levels of rurality for Blacks. Finally, when studying mortality across levels of rurality by region, we can see that opioid mortality appears to have gotten worse over time everywhere, but especially in the Northeast and Midwest. In comparison for HIV, the largest improvements were seen in large central metropolitan areas of the Northeast and South.

Implications

While the media has highlighted alarming examples of the injection of opioids leading to HIV outbreaks over the past few years, our results do not find evidence of a positive association or relationship between HIV mortality and opioid mortality over time from a national perspective. Instead, it appears that the U.S. made considerable strides in reducing HIV mortality even as opioid use and abuse grew and resulted in increased opioid mortality. Importantly, mortality is an imperfect measure to use in studying the relationship between opioids and HIV. As treatment for HIV has increased and improved over the past few decades, life expectancy has risen dramatically.[17] Therefore, even if the acceleration of the opioid epidemic in recent years has increased HIV rates, it may not yet have manifested in increased mortality. With that said, our extended period of analysis of national data does suggest that the two trends are not positively correlated historically. Additional research is needed to look at the relationship between HIV and opioids in rural and urban America outside the mortality context. Potentially fruitful avenues for investigation include studies of disease burden and hospitalization. Furthermore, research in future decades should continue to evaluate the trends presented here to explore whether the growth in the opioid epidemic eventually becomes associated with changes in HIV-related mortality.

Our research also points to the need for targeted interventions to further reduce mortality rates from HIV and opioids. For HIV, while important strides have been made in reducing mortality in large central metropolitan areas, further improvements are warranted. Efforts could include continuing programs that have helped to successfully lower the mortality rate in large central metropolitans to this point, as well as targeting subpopulations who continue to have the highest mortality rates in large central metropolitan areas –i.e. men and Blacks. For opioids, continued efforts are needed across the urban-rural spectrum to combat the epidemic. This includes continued investment in research, efforts to educate doctors and the public about the dangers of prescription opioids, the use of medication assisted therapy, and improved access to affordable drug rehabilitation. These efforts are particularly important in light of new evidence suggesting that the COVID-19 pandemic has increased opioid-related mortality in 2020.[18]

Limitations

There are several limitations to this research. In cases where the death count for a particular measure of interest (i.e., HIV mortality for noncore Midwest residents in 2015) is below 20, the CDC WONDER considers that data to be unreliable. In our analysis, three values were considered to be unreliable by the WONDER: HIV mortality for the Northeast noncore and micropolitan areas in 2015, HIV mortality for Hispanics in small metropolitan areas in 2016, and opioid mortality for Blacks in noncore areas in 1999.[†††] Given the unreliable nature of these individual estimates, they should be interpreted with caution and in relation to reliable rates in years before and after the years in question. In addition, even if the opioid epidemic is increasing rates of HIV, those changes may not manifest in our data yet given our focus on mortality and the growing life expectancy for HIV over time.

††† Even after combining noncore and micropolitan areas into a non-metropolitan category, data were still suppressed for HIV mortality in non-metropolitan areas in the northeast for 2015 and for opioid mortality for blacks in non-metropolitan areas in 1999.

References

1. https://www.npr.org/sections/health-shots/2020/02/16/801720966/5-years-after-indianas-historic-hiv-outbreak-many-rural-places-remain-at-risk
2. Schranz, A. J., Barrett, J., Hurt, C. B., Malvestutto, C., & Miller, W. C. (2018). Challenges facing a rural opioid epidemic: treatment and prevention of HIV and hepatitis C. Current HIV/AIDS Reports, 15(3), 245-254.
3. Schwetz T. A., Calder, T., Rosenthal, E., Kattakuzhy, S., & Fauci, A. S. (2019). Opioids and Infectious Diseases: A Converging Public Health Crisis. The Journal of infectious diseases.
4. Vulnerable Counties and Jurisdictions Experiencing or At-Risk of Outbreaks. 2018. The Centers for Disease Control and Prevention. July 19, 2018. https://www.cdc.gov/pwid/vulnerable-counties-data.html
5. Dawson, Lindsey and Jennifer Kates. 2018. HIV and the Opioid Epidemic: 5 Key Points. Kaiser Family Foundation. March 27, 2018. https://www.kff.org/hivaids/issue-brief/hiv-and-the-opioid-epidemic-5-key-points/
6. Van Handel, M. M., Rose, C. E., Hallisey, E. J., Kolling, J. L., Zibbell, J. E., Lewis, B., ... & Iqbal, K. (2016). County-level vulnerability assessment for rapid dissemination of HIV or HCV infections among persons who inject drugs, United States. Journal of acquired immune deficiency syndromes (1999), 73(3), 323.
7. Surratt, H., Kurtz, S. P., & Cicero, T. J. (2011). Alternate routes of administration and risk for HIV among prescription opioid abusers. Journal of addictive diseases, 30(4), 334-341.
8. Chan, A. C., Palepu, A., Guh, D. P., Sun, H., Schechter, M. T., O'Shaughnessy, M. V., & Anis, A. H. (2004). HIV-positive injection drug users who leave the hospital against medical advice: the mitigating role of methadone and social support. JAIDS Journal of Acquired Immune Deficiency Syndromes, 35(1), 56-59.
9. Young, A. M., Havens, J. R., & Leukefeld, C. G. (2010). Route of administration for illicit prescription opioids: a comparison of rural and urban drug users. Harm reduction journal, 7(1), 24.
10. Havens, J. R., Oser, C. B., & Leukefeld, C. G. (2011). Injection risk behaviors among rural drug users: implications for HIV prevention. AIDS care, 23(5), 638-645.
11. Weissman, S., Duffus, W. A., Iyer, M., Chakraborty, H., Samantapudi, A. V., & Albrecht, H. (2015). Rural-urban differences in HIV viral loads and progression to AIDS among new HIV cases. Southern medical journal, 108(3), 180-188.
12. Centers for Disease Control and Prevention, National Center for Health Statistics. Multiple Cause of Death 1999-2018 on CDC WONDER Online Database, released in 2020. Data are from the Multiple Cause of Death Files, 1999-2018, as compiled from data provided by the 57 vital statistics jurisdictions through the Vital Statistics Cooperative Program. Accessed at http://wonder.cdc.gov/mcd-icd10.html on Jul 7, 2020 10:48:53 AM
13. National Center for Health Statistics. (2014). 2013 NCHS urban-rural classification scheme for counties. Vital Health Stat, 2.
14. Joinpoint Regression Program, Version 4.7.0.0. February, 2019; Statistical Research and Applications Branch, National Cancer Institute.
15. Clegg, L. X., Hankey, B. F., Tiwari, R., Feuer, E. J., & Edwards, B. K. (2009). Estimating average annual per cent change in trend analysis. Statistics in medicine, 28(29), 3670-3682.
16. Watson, M., Johnson, S. D., Zhang, T., & Oster, A. M. (2019). Characteristics of and trends in HIV diagnoses in the Deep South region of the United States, 2012–2017. AIDS and Behavior, 23(3), 224-232.
17. Wandeler, G., Johnson, L.F. and Egger, M. (2016). Trends in life expectancy of HIV-positive adults on ART across the globe: comparisons with general population. Current Opinion in HIV and AIDS, 11(5), p.492.
18. American Medical Association. (2020). "Issue brief: Reports of increases in opioid related overdose and other concerns during COVID pandemic." American Medical Association Advocacy Resource Center. July 8, 2020.
19. https://www.ama-assn.org/system/files/2020-07/issue-brief-increases-in-opioid-related-overdose.pdf
20. About HIV. 2021. The Centers for Disease Control and Prevention. April 7, 2021. https://www.cdc.gov/hiv/basics/whatishiv.html
21. What is HIV. 2020. HIV.gov. June 5, 2020. https://www.hiv.gov/hiv-basics/overview/about-hiv-and-aids/what-are-hiv-and-aids
22. Miller, Elena. 2017. Clarifying Coding for HIV and AIDS in ICD-10. Journal of AHIMA. June 15, 2017. https://journal.ahima.org/clarifying-coding-for-hiv-and-aids-in-icd-10/

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