

Wright State University

CORE Scholar

Scholarship in Medicine - All Papers

Scholarship in Medicine

2021

Human Immunodeficiency Virus (HIV) – An Analysis of Trends in HIV Diagnoses from 2008 – 2018

Ulysses G. Gardner

Follow this and additional works at: https://corescholar.libraries.wright.edu/scholarship_medicine_all



Part of the [Public Health Commons](#)

Human Immunodeficiency Virus (HIV) –
An Analysis of Trends in HIV Diagnoses from 2008 – 2018

Ulysses Grant Gardner, Jr.

Dr. Amber Todd – Office of Medical Education

Public Health, Population Health & Global Health

Scholarship in Medicine Final Report

By checking this box, I indicate that my mentor has read and reviewed my draft proposal prior to submission

Abstract

Objective: An estimated 1.1 million people are living with the human immunodeficiency virus (HIV) in the United States. Despite over two decades of research, a cure for HIV has not been approved and it remains a pandemic. This research study was conducted to determine the statistical significance in HIV incidence based on diagnoses in 2008 versus 2018; age groups 25-34 years old versus 55+ years old; Black versus Hispanic versus White; male versus female; and geographical location. *Methods:* This retrospective study was conducted using data from the Center for Disease Control and Prevention (CDC) Atlas Plus data sets, a collection of surveillance data from previous years. Analysis was done using paired t-test for prevalence comparison by year and unpaired t-test for age and sex. ANOVA test was used to compare prevalence by race. Descriptive analysis was done using z-scores to determine differences in HIV rates by state. *Results:* Incidence by rate from 2008 versus 2018 using a 2-tailed t-test resulted as $t_{50}=1.99$, $P=.052$ indicating no statistical significance in incidence in comparison. Analysis of incidence in age groups 25-34 versus 55+ resulted as $t_{50}=9.69$, $P<.001$, indicating a statistical significance. Analysis of incidence by race resulted as $F_{2,150}=46.23$, $P<.001$, indicating a statistically significant difference between races. Analysis of incidence by sex resulted as $t_{50}=7.80$, $P<.001$, indicating a statistically significance difference between males and females. Analysis of incidence in states using descriptive analysis resulted as mean 10.67 (SD 7.21). Outliers include District of Columbia with z-score 3.32 and southern states Florida, Georgia, and Louisiana with z-score 2.07, 2.57, and 2.06 respectively.

Key Words: HIV; prevalence; incidence; surveillance

Introduction

Since the first case of confirmed human immunodeficiency virus (HIV) in 1959¹ and its recognition in 1981 as an infectious disease, biomedical and scientific research advances have led to successful treatment regimens, prevention strategies, and improved care for persons living with this once fatal disease. Although knowledge and treatment options have expanded with exposure prophylaxis, HIV incidence and prevalence remain high worldwide. With an estimated 1 million people living with the disease in the United States and over two decades of research, surprisingly there is still not an approved cure for HIV leading to an ongoing pandemic.² In 2018, 37,832 people received a diagnosis of HIV in the United States and dependent areas. 69% were among men who have sex with men, 24% among heterosexuals, and 7% among IV drug users. The highest incidence by age was in the 24-34 age group with 13,458 new diagnoses. Blacks accounted for the highest percentage by race of new cases (42%), Hispanic/Latinos (27%), Whites (25%). Regionally, the highest diagnosis rate (per 100,000 people) was in the South (15.7) and the least in the Midwest (7.2).³

Fortunately, the incidence of HIV infection has declined in the United States since the implementation of the National HIV/AIDS Strategy in 2010.⁴ The vision of the National HIV/AIDS Strategy is for HIV incidence to be low in the United States. It states that every person regardless of age, gender, race/ethnicity, sexual orientation, gender identity or socio-economic circumstance will have quality care without humiliation.⁵ In 2019, the United States Department of Health and Human Services (HHS) proposed a new initiative to reduce incidence in the United States by up to ninety percent in ten years. The initiative key strategies include diagnosing HIV infections rapidly after acquisition; treating effectively to sustain decreased to undetectable viral load; protecting high-risk populations with prophylactic treatments; and

recognizing and responding to geographical areas with high incidence to prevent transmission.²

To implement such an initiative, it is important to recognize trends in HIV prevalence and incidence.

This research study was conducted using data from the Center for Disease Control and Prevention (CDC) to determine the statistical significance in HIV incidence based on year of diagnosis, age, race, sex, and geographical location. At the time of this research, no other studies were found that looked at this data for the aforementioned variables.

Hypothesis/Specific Aims/Research Questions

Research questions:

1. Is the HIV diagnosis rate significantly different in all races and both sexes ages 13 years and older from reported cases in 2008 compared to 2018?
2. Is the HIV diagnosis rate significantly different in all races and both sexes in age groups 25-34 compared to age 55+?
3. Is the HIV diagnosis rate significantly different in both sexes, ages 13 years and older across races (Blacks, Hispanics, Whites)?
4. Is the HIV diagnosis rate significantly different in all races ages 13 years and older across gender?
5. Is the HIV diagnosis rate significantly different in all races and both sexes ages 13 years and older in the different states within the United States?

Methods

Data Collection

To answer the research questions, data was taken from the Center for Disease Control and Prevention (CDC) Atlas Plus data sets. These data sets are collections of surveillance data collected by the CDC from more than 15 years.⁶ The data sets included are

- a. HIV diagnoses | 2008-2018 | Ages 13 years and older | All races/ethnicities | Both sexes | All transmission categories | By State
- b. HIV diagnoses | 2018 | Ages 13 years and older | All races/ethnicities | Both sexes | All transmission categories | By State

Data points for American Samoa, Guam, Northern Mariana Islands, Puerto Rico, and U.S. Virgin Islands were excluded from this analysis.

Data Analysis

All analysis was completed using IBM SPSS Statistics v. 26 software.

RQ1: Is the HIV diagnosis rate significantly different in all races and both sexes ages 13 years and older from reported cases in 2008 compared to 2018?

Analysis by paired t-test by state of HIV prevalence in 2008 versus 2018.

RQ2: Is the HIV diagnosis rate significantly different in all races and both sexes in age group 25-34 compared to age 55+?

Analysis by unpaired t-test by state of HIV prevalence in age group 25-34 versus 55+.

RQ3: Is the HIV diagnosis rate significantly different in both sexes, ages 13 years and older in across races (Blacks, Hispanics, Whites)?

Analysis by ANOVA by state of HIV prevalence in Blacks versus Hispanics versus Whites.

RQ4: Is the HIV diagnosis rate significantly different in all races ages 13 years and older across gender?

Analysis by unpaired t-test by state of HIV prevalence in males versus females.

RQ5: Is the HIV diagnosis rate significantly different in all races and both sexes ages 13 years and older in the different states within the United States and the dependent areas?

Analysis by descriptive statistics using z-scores to determine difference in HIV diagnosis rate between states.

Results

On analysis, race, age, and sex were associated with statistical significance in rate of incidence difference ($P < .001$ for all categories). The rate of incidence was not significant between years 2008 and 2018 ($P = .052$) with a mean rate of incidence of 17.22 and 10.67 in 2008 and 2018, respectively. A summary of all analyses is outlined in the Table.

Table: Mean Rate of Incidence of HIV in the United States and Washington, D.C

	n	Mean Rate	SD	P value
Year				.052
2008	51	17.22	28.14	
2018	51	10.67	7.21	
Age (in years)				<.001^a
25-34	51	22.65	14.12	
55+	51	3.16	2.65	
Race				<.001^a
Black	51	39.69	17.25	
Hispanic	51	19.58	26.68	
White	51	4.80	2.42	
Sex				<.001^a
Male	51	17.52	11.81	
Female	51	4.15	3.24	

Abbreviations: n, sample size; SD, Standard Deviation; ^astatistical significance

Analysis of RQ1-4 are summarized in this table. RQ1 (year): No significant difference between 2008 and 2018 ($t = 1.99$, $P = .052$); Paired t-test. RQ2 (age): Significant difference between age

groups 25-34 and 55+ ($t = 9.69$, $P < .001$); Unpaired t-test. RQ3 (race): Significant difference between Black, Hispanic, and White individuals ($F = 46.27$, $P < .001$); ANOVA. RQ4 (sex): Significant difference between males and females ($t = 7.797$, $P < .001$); Unpaired t-test.

Discussion

Analysis of HIV rate of incidence in 2008 compared to 2018 in the United States resulted in $P=0.052$ which is not significant. The mean rate in 2008 was 17.21 (SD 28.14) and in 2018 was 10.67 (SD 7.21). Although the data rate of change is not significantly different there has been consistent decrease in the number of new cases of HIV since 2008, most specifically in areas with higher incidence and prevalence of HIV. The rate of incidence in the District of Columbia, which has the highest rate of incidence, decreased by 168% from 2008 to 2018. The Southern states, specifically Florida and Georgia, which contribute the greatest number of HIV new cases annually saw a decrease of 11.6% and 11.1%, respectively.

Analysis of 2018 rate of incidence in age groups 25-34 versus 55+ resulted as $t_{50}=9.69$, $P<.001$, indicating a statistically significance between age groups which is consistent with published data.³ The mean rate of incidence per 100,000 people was 22.65 and 3.16 in the 25-34 and the 55+ year old age groups, respectively. This indicates a vast difference in rate of new cases in comparison. In recent years, there has been a decline in incidence in the age group less than 25 years of age⁷ which previously was the group with the highest incidence of HIV. Incidence is now highest in the 25-34 age group with an estimated 13,500 new cases in 2018. A potential cause for this documented increase in this age group is increased availability of HIV testing and use of pharmaceuticals that prevent transmission of the virus. Drugs like Truvada, approved in 2012 by the Food and Drug Administration, have been shown to reduce the relative risk of acquisition of HIV if taken daily with the use of safer sex practices.⁸ To be eligible for such therapeutics, patients must test negative for the virus which increase testing numbers and ultimately identify more patients who test positive. Individuals at increased risk of becoming HIV positive can now take such drugs at an early age to significantly decrease those risks.

People in the 25-34 age group are being tested more frequently leading to an increase in known incidence in this age range. The 13-24 age group with less exposure to high risk practices has, again, shown a decrease in incidence likely because of such interventions. New cases over the age of 55 have consistently been the lowest of all age groups. New number of new cases in this group were an estimated 3,900 in 2018.⁷

Analysis of 2018 rate of incidence in Blacks, Hispanics, and Whites resulted as $F_{2,150}=46.23$, $P<.001$, indicating a statistically significant difference between ethnic groups. Blacks and Hispanics are disproportionately affected at higher rates in comparison to Whites. The rate of incidence was 39.69 for Blacks; 19.58 for Hispanics; and 4.80 for Whites. Overall, blacks had the highest incidence with an estimated 16,000 new cases in 2018.³ The higher number of cases in Blacks and Hispanics is thought to be due to lower socioeconomic status and perceived stigma towards the healthcare community. Blacks and Hispanics also have decreased access to healthcare which decreases testing availability and adequate management if the virus is acquired. 69% of new cases of HIV in 2018 were attributed to men who has sex with men (MSM)⁷, with the highest proportion being in the Black community. A study from Northwestern University concluded that although the number of new cases of HIV is roughly 16 times higher in Black men who engage in MSM behaviors versus their white counterparts, their high-risk behaviors are less.⁹ Blacks reports higher testing rates and lower unsafe sexual practices; however, they have a more socially connected network which increases their chances of acquiring the disease epidemiologically. Other identified findings that attribute to the disparities between races include Blacks have a higher prevalence of HIV and levels of trauma, childhood abuse, and victimization.⁹⁻¹⁰

Analysis of rate of incidence in males versus females resulted as $t_{50}=7.80$, $P<.001$, indicating a statistically significance between males and females. Rate of incidence was 17.52 in men and 4.15 in women. The number of new cases is an estimated 30,521 and 7,179 in men and women³, respectively according to the CDC. The highest incidence of HIV was through MSM sexual contact, as discussed above, which has been consistent with data from past years. Incidence has been decreasing in women since 2010 with a decline of 24% in 2018. Of the new cases in women, 85% were acquired through heterosexual sexual contact.⁶

Analysis of rate of incidence in states using descriptive analysis resulted as mean 10.67 (SD 7.21). District of Columbia was an outlier with z-score 3.32 and southern states Florida, Georgia, and Louisiana with z-score 2.07, 2.57, and 2.06 respectively were greatly different from the other states. This data is consistent with published data. The highest incidence of HIV by region, accounting for greater than half of the cases³, is the Southern region inclusive of Florida, Georgia, and Louisiana but interestingly only about 35% of the population lives in this region. The rate of incidence for these states are 25.6 (Florida), 29.2, (Georgia) and 25.5 (Louisiana). Factors that lead to the great propensity of acquiring HIV in the South in comparison to other regions have been noted as poverty and unemployment; a decreased uptake in the use of pre-exposure prophylaxis; and decreased health insurance. Stigma is also highly prevalent in Southern states around sexual orientation, substance use disorders, and poverty which leads to a decrease in affected populations seeking prevention and treatment.¹⁰ The District of Columbia has the highest number of cases per 100,000 people with a rate of 34.6 whereas Maine had the lowest rate at 2.4. The District of Columbia has consistently had the highest number of new cases of HIV yearly for decades. However, with the efforts such as the End the HIV Epidemic in DC 2020, the number of new cases is now decreasing at about 4% annually.¹¹

Conclusion

Great strides have been made to decrease incidence of HIV worldwide but with numbers exceeding 35,000 annually and a prevalence of more than 1.1 million people living in the U.S.,² it is evident that more work is needed. A key error that should be targeted is access to quality care including testing, antiretroviral therapy, and sustained follow-up to with primary care providers to ensure proper education and compliance. Studies have shown that retention and reengagement with health care professionals is vital in the efforts to decrease HIV and AIDS in all populations.¹²

As evident by the evidence presented in this review, disparities exist in HIV/AIDS screenings, diagnoses, and treatment as Blacks and Hispanics are significantly more likely to be diagnosed when compared to Whites. This is linked to a decrease in access to care in these vulnerable populations as well as a decrease in health literacy, socioeconomic status, and a general mistrust of the healthcare system.⁹ As infectious disease research moves forward, it is important to include minorities in studies and trials to close the gap that exists leading to inequities and inequalities. Fortunately, with the onset of prevention strategies, the number of new cases is continuing to slowly decline annually with the hope of no transmission of the virus and ultimately a cure.

This population study research was limited by estimated numbers from the CDC database. This research may be continued by stratifying the rate of new cases by availability of resources by states and communities. Inclusion of new data from beyond 2018 should also be studied to follow trends in incidence, geographic location, age, and ethnicity. Prevalence should also be added to this study as people are living normal lifespans with increasing understanding of HIV and the use of pharmaceuticals to increase prevention and decrease transmission.

References

1. Simons, S. "The HIV Crisis in America: The Long Road to Action" (2019). *For All the People Video*. 6. https://thekeep.eiu.edu/lib_exhibits_health_reform_video/6
2. Fauci AS, Redfield RR, Sigounas G, Weahkee MD, Giroir BP. Ending the HIV Epidemic: A Plan for the United States. *JAMA*. 2019;321(9):844–845. doi:10.1001/jama.2019.1343
3. HIV Basics. Center for Disease Control and Prevention website. <https://www.cdc.gov/hiv/basics/index.html>.
4. Johnson AS, Song R, Hall HI. Estimated HIV Incidence, Prevalence, and Undiagnosed Infections in US States and Washington, DC, 2010-2014. *J Acquir Immune Defic Syndr*. 2017;76(2):116-122.
5. Millett GA, Crowley JS, Koh H, et al. A Way Forward: The National HIV/AIDS Strategy and Reducing HIV Incidence in the United States. *J Acquir Immune Defic Syndr*. 2010;55:S144-S147.
6. Centers for Disease Control and Prevention. NCHHSTP AtlasPlus. Updated 2019. <https://www.cdc.gov/nchhstp/atlas/index.htm>.
7. HIV U.S. Statistics. U.S. Department of Health & Human Services website. <https://www.hiv.gov/hiv-basics/overview/data-and-trends/statistics>
8. Truvada. What is Truvada for PrEP? www.truvada.com
9. Marla, P. Young black gay men have vastly higher HIV rates yet fewer partners and more frequent testing. *Northwestern Now*, 2018. <https://news.northwestern.edu/stories/2018/december/young-black-gay-men-have-vastly-higher-hiv-rates-yet-fewer-partners-and-more-frequent-testing/>

10. Centers for Disease Control. HIV in the Southern United States. 2019.

<https://www.cdc.gov/hiv/pdf/policies/cdc-hiv-in-the-south-issue-brief.pdf>

11. District of Columbia Center for AIDS Research. DC Department of Health Releases 2019 Annual HIV/AIDS Epidemiology and Surveillance Report for Washington, DC. 2019.

<https://dccfar.gwu.edu/dc-department-health-releases-2019-annual-hivaids-epidemiology-and-surveillance-report-washington-dc>

12. Perry A, Kasaie P, Dowdy DW, Shah M. What Will It Take to Reduce HIV Incidence in the United States: A Mathematical Modeling Analysis. *Open Forum Infect Dis.* 2018;5(2):ofy008.

Published 2018 Jan 6. doi:10.1093/ofid/ofy008