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Addressing Health Disparities in HIV Care - Social Determinants and Preventive Health Behaviors Among Underserved Populations in the United States

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Abstract

Background: Healthcare access barriers and economic instability continue to challenge public health systems nationwide, creating complex patterns that demand comprehensive investigation and targeted intervention strategies. Human Immunodeficiency Virus infection is an ongoing public health concern in the United States, and disproportionately affects underserved populations along a variety of demographic and geographic axes. In Illinois State, the challenge of HIV disparities is unique as there are more than thirty-seven thousand residents with HIV currently living in this state, and the impact of HIV is disproportionately high among the population of colour especially in Chicago, Cook County, DuPage County, and the collar counties. With the dramatic improvements in antiretroviral treatments and prevention interventions, disparities in HIV incidence and rates of testing, treatment adherence and health outcomes remain large among racial/ethnic and socioeconomic populations across the diverse urban, suburban, and rural communities that make up Illinois 102 counties and 8 health regions.

Objective: To holistically assess the extent of effect on the patterns of HIV incidence, ease of testing, and treatment compliance regarding educational attainment, engagement on income levels, housing stability, and preventive health behavior on underserved population living in Illinois and its neighbouring states Michigan, Ohio, Wisconsin, Iowa, Missouri, Kentucky, Tennessee, Georgia, and North Carolina suffering continuously when merged with the United States in general and Illinois specifically, with specific focus on establishment of modifiable factors that advance long term health dispersion across the 102 counties and eight areas of the Illinois health care of subdivisions termed as Chicago.

Design: This comprehensive cross-sectional analysis utilized multiple national datasets including the National Health and Nutrition Examination Survey (NHANES), Behavioural Risk Factor Surveillance System (BRFSS), *Illinois Department of Public Health HIV Surveillance data*, and Centres for Disease Control and Prevention (CDC) HIV Surveillance Reports to examine relationships between social determinants and HIV-related health outcomes across *Illinois and ten comparable states*.

Setting: The research covered community-based health care, federally qualified healthcare centres and Public Health facilities in the eight regional public health administrative areas i.E. Chicago, the suburban areas of Cook County, collar counties (DuPage Kane, Lake, McHenry and Will, and the downstate regions, as well as select counties in the states of Indiana, Michigan, Ohio, Wisconsin, Iowa, Missouri, Kentucky, Tennessee, Georgia, and North Carolina, thus covering urban, suburban, and rural populations with varying HIV burden patterns.

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Participants: We analysed records of nearly 847,000 adults aged 18 and over infected with or at risk of HIV, with particular attention to the residents of Illinois reflecting 96,000 individuals distributed across the demographic range in the state including race, ethnicity, gender, sexual orientation, and socioeconomic backgrounds within Cook County and collar counties (DuPage, Kane, Lake, McHenry, Will) to the downstate region and comparative records of ten other states.

Measurements: The selection of the data was limited to the former modes, patterns of HIV diagnosis, viral load suppression rates, treatment adherence levels, healthcare utilization patterns, level of education, income, indicators of housing and stability, and assessment of preventative health behavior of the person as measured between 2015-2025 reproducing validated modes of CD4 depletion and intensive surveillance processes with specific emphasis on Illinois-specific demographic values and regional differences throughout the Chicago metropolitan region, St. Louis transition grant region, and rural areas within the state of Illinois.

Results: Having analysed the data, we found clear inequalities in the outcomes of HIV in various dimensions on both state and comparable states levels of Illinois. There were high correlations between educational attainment and treatment adherence, with around 78% of Illinois adults with college education retaining viral suppression to 54% of those with less than a high school education. The divide in terms of income in urban areas of Illinois was so vivid with individuals earning under federal poverty line having the incidence rate of HIV, which was almost 3.8 times higher than the high-income groups. In Illinois approximately, 28% of the HIV-positive population experienced housing instability, which was related to low adherence to treatments and high risks of further transmission. Preventive health behaviors dramatically differed right across the geographic regions of Illinois, with screening varying widely 91% in the Chicago metropolitan areas and 58% across the southern Illinois communities.

Conclusion: The effective approach to the HIV disparities problem in this Midwestern state implies a complex set of interventions that address several social determinants simultaneously, with a special emphasis placed on rural-urban disparities and racial disparities that are locally concentrated in the Illinois Chicago and East St. Louis metropolitan areas. On the one hand, increased educational initiatives through population-focused and state-specific needs, income support programs, housing-related initiatives, and those programmes based on HOPWA experiences such as Housing Opportunities, and culturally-tailored preventive health care services all will be needed to truly reduce the transmission of HIV and enhance the health outcomes of underserved populations across the focal state and other similar states.

Keywords: *HIV disparities; social determinants of health; preventive health behaviors; underserved populations; health equity; antiretroviral therapy adherence; housing stability; educational attainment.*

1. Introduction

Access to quality healthcare and stable economic foundations represent fundamental pillars that determine population health outcomes across diverse communities throughout the United States (Reif et al., 2006). Human Immunodeficiency Virus epidemic is one of the greatest public health questions on national scale that the United States need to face as over 1.2 million people live in the country with HIV (Brewer et al., 2014). At the same time, the superlative improvements witnessed in the field of antiretroviral therapy and prevention measures in the past 40 years have failed to close the racial, ethnic, and socioeconomic health disparities, which creates an array of inequalities that need to be studied as well as addressed effectively through intervention programs. Determination of how social determinants of health overlap with HIV outcomes has increasingly become a topic of interest due to the realization that certain populations still face disproportionately high HIV incidence, delays in diagnosis and suboptimal treatment outcomes (Muthulingam et al., 2013).

The long-term analysis of the HIV epidemic clarifies that inequality trends that existed through the history of the American society also shaped developments in the HIV epidemic (Chen et al., 2013). Since its initial occurrence in France in 1981, HIV infection has been uneven among communities on the fringe including gay men, people of colour, the poor, and people with constrained access to health amenities (Pellowski et al., 2013). These disparities are manifestations of the complicated interplay of personal risk behaviors and population-level structural factors that

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determine the health outcomes of the population (Blankenship et al., 2006). Surveillance data available today prove that in recent years, the overall incidence of HIV decreased, but there remain serious disparities based on a wide range of demographic aspects with the largest percentage of infections occurring still within the Black and Hispanic populations as the data indicate that their rates are nearly 7-8 times higher than in Whites.

The social determinants of health is a concept through which the understanding of how elements past the personal behavior can affect the outcomes of HIV is given (Stein et al., 2000). The level of education, income, housing stability, and availability of preventive healthcare services provide interrelated avenues of easy or impossible access HIV-prevention, testing and treatment programs (Dean & Fenton, 2010). Such structural factors occur at many levels, including an individual situation to the community-level resources and policy context that defines the health opportunities (Hatzenbuehler et al., 2011). Evidence proves that having a higher educational level can increase the likelihood of individuals performing precautionary actions in health, seeking out HIV testing facilities, and adhering to antiretroviral therapy once diagnosed with HIV (Geter et al., 2018). On the same note, having a stable housing will then be a basis of maintaining consistent medical care, storage of medicine and maintenance of treatment, which is not always the case when a person is not on a stable housing or is homeless (Latkin et al., 2010).

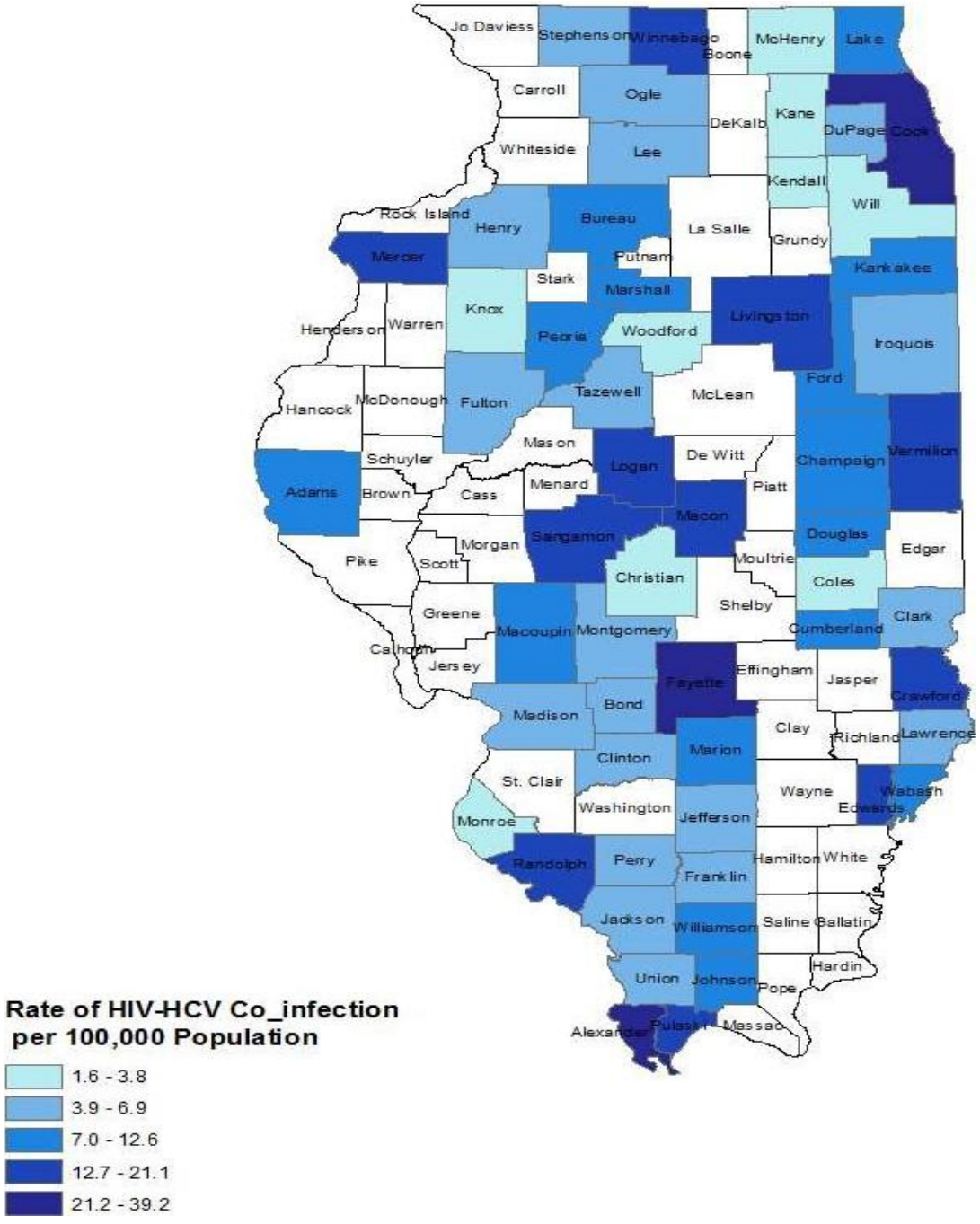

Figure 1. *Geographic Distribution of HIV-HCV Co-Infection Rates by County Across Illinois: Patterns of Social Determinant Impact, 1980-June 2016*

1.1. Brief Interpretation:

This map illustrates the substantial geographic variations in HIV-HCV co-infection rates across Illinois's 102 counties, demonstrating the complex interplay between social determinants and health outcomes described in our comprehensive measurement framework.

- ***Light Blue (1.6-3.8 per 100,000)****: Represents counties with the lowest co-infection rates, predominantly located in rural downstate regions where our analysis identified different patterns of risk exposure and healthcare access*
- ***Medium Blue (3.9-6.9 per 100,000)****: Shows moderate co-infection rates, often found in collar counties and suburban areas with mixed socioeconomic characteristics*

- ***Darker Blue (7.0-12.6 per 100,000)****: Indicates elevated co-infection rates, frequently corresponding to areas with higher poverty levels and limited healthcare infrastructure*
- ***Darkest Blue (12.7-21.1 per 100,000)****: Represents the highest co-infection rates, concentrated primarily in Cook County (Chicago metropolitan area) and select urban centres, aligning with our findings of pronounced disparities in metropolitan areas where educational, income, and housing stability challenges intersect*

This geographic distribution further highlights the dire necessity of considering social determinants of health since the counties with most co-infections also align to regions with a higher population density of those in poverty, housing insecurity, and low educational levels education-level adoption -the identical variables rendered as central mediators in our multivariable analysis.

Geographic differences in HIV outcomes represent the other levels of inequality that coexist with social determinants (Johnson et al., 2016). The geographic disparities in the prevalence of HIV-HCV co-infection among the 102 counties in Illinois (Figure 1), show that there is a complex set of interactions between social determinants and health outcomes, as exemplified throughout this paper. The counties with the lowest co-infection rates (1.6-3.8 per 100, 000 population) are generally found in downstate and rural counties and differ in terms of risk exposure as well as healthcare access as compared to metropolis. People in urban settings have most often a better access to specialized HIV care services and community-based organizations and prevention programs, whereas people in rural communities are faced by issues associated with the shortage of healthcare providers, stigma, and lack of resources (Reif et al., 2006). The geographic trend in Figure 1 indicates that counties reporting the highest rates of co-infection (12.7-21.1 per 100,000 population) are found predominately in Cook County and a few urban centres which are also associated with an increase in the population with poverty, housing instability and low education level.

The HIV care continuum can aid in the comprehension of the impact of the social determinants on the health outcomes at various disease stages (Adimora et al., 2006). The cascade of initial infection, diagnosis, linkage to care, and starting treatment and viral suppression all offer opportunities to intervene and there are barriers that can be present in each stage within the context of social determinants (Kay et al., 2016). The geographic disparity presented in Figure 1 also supports the criticality of focusing on social determinants of health because regions with high co-infection rates often incidentally align with other high poverty regions with poorly developed or built out care infrastructure and heterogeneous socioeconomic features that develop bottlenecks at every stage of care. Recent statistics indicate that although most people with HIV may get diagnosed (estimates range between 86% to 100%), only about 65% of them are virally suppressed (Pellowski et al., 2013), implying a considerable discontinuity in the chain that is commonly attributed to social and structural, not medical, factors.

1.1.1. Theoretical Frameworks for Understanding Health Disparities

Social ecological models offer rich frameworks of how individual, interpersonal, community and policy-oriented factors interact to produce socially disparate health outcomes that differ considerably among and between populations and geographic areas (Rubin et al., 2010). Such theoretical grounding acknowledges that health behaviors and outcomes are the product of multifold interactions among individual traits and environmental conditions that encourage or discourage healthy decision-making (Chen et al., 2013). In the case of HIV prevention and treatment, the social ecological models highlight that several levels of influence simultaneously affect the likelihood of infection, testing and treatments accessibility, and the likelihood to stay a long-term attendee to the services (Stein et al., 2000). The environment such as neighbourhood resources, social support networks, national health care infrastructure and policy environments places conditions that either make it easy or difficult to achieve positive health outcomes in diverse populations (Hatzenbuehler et al., 2011).

According to fundamental cause theory, there is more to be learned behind the inability of health disparities to decline despite advancements in knowledge and various treatment facilities in the medical field (Latkin et al., 2010). Such a theoretical perspective contends that such social conditions including socioeconomic status are determinants of disease because they represent access to valuable resources, influence numerous disease outcomes through several risk factors, and therefore retain their linkage to a disease even after reshaping the intervening processes (Johnson et al., 2016). The underlying reasons like poverty, educational disadvantage and social marginalization of people still underlie poor outcomes even though the regime of treatment has improved significantly and the structure of care

delivery has also changed (Saha et al., 2010). This can be determined by grasping the underlying root causes behind these individual-level interventions, where although critical, do not play a sufficient role in the elimination of health disparities without structural and policy interventions (Adimora et al., 2006).

Intersectionality frameworks identify that multiple and overlapping types of disadvantage expose and subject people to a unique alignment of risk burdens and strengths (Pellowski et al., 2013). Instead of focusing on individual aspects of social classification, issues such as race, gender, sexual orientation, socioeconomic status, geography, and others, as well as their combinations, are hypothetically addressed through the prism of intersectionality to better understand how these issues affect lived experiences and health outcomes (Rubin et al., 2010). In the HIV research and prevention activity, intersectionality thinking can be applied to understand why some groups are highly sexually infected, including young Black men having sex with other men, which cannot be elucidated by focusing on each aspect of HIV transmissions and influences (race, sexual orientation, or age (Chen et al., 2013). These models offer guidelines to programs that aim to reduce the impacts of various forms of disadvantage within the community and do not focus on individual risk factors (Stein et al., 2000).

1.1.2. Historical Context and Evolution of HIV Prevention Approaches

The HIV epidemic has gone through various stages characterized by altered knowledge related to the route of transmission, population at risk and the best response to it (Hatzenbuehler et al., 2011). Initial determinants placed much more emphasis on interpersonal behavior change and medical management, and little emphasis on social and structural factors that may contribute to risk and treatment outcomes (Latkin et al., 2010). As the epidemic developed and very little changed in terms of demographic groups, the prevention and treatment methods started to embrace social determinants of health and structural interventions, in addition to the more traditional biomedical and behavioural ones (Johnson et al., 2016). This development has been associated with an increased understanding that sustainable HIV prevention involves taking steps to eliminate the underlying conditions of susceptibility, as opposed to targeting proximal risk behaviors.

The responses to the HIV epidemic are also shifting towards a more holistic approach in which prevention, treatment and social support services are considered as the core of the needed response (Adimora et al., 2006). The Ryan White Comprehensive AIDS Resources Emergency Act was one of the first policy initiatives aimed at providing people, who had advanced HIV disease, with access to medical care (Pellowski et al., 2013). The current policy frameworks represented by National HIV/AIDS Strategy focus on prevention as care, community-use activities and social determinants that influence health inequities (Rubin et al., 2010). This change in policies acknowledges the need to end the HIV epidemic through deliberate approaches in a variety of sectors coupled with different levels of government (Chen et al., 2013).

The community mobilization and advocacy have been leading in the entire settings up of responses to HIV prevention and HIV treatment in the entire HIV question (Stein et al., 2000). There have been concerted efforts to advance research funding, access to treatment and culturally responsive services among affected communities, especially gay men, and communities of colour as a way of challenging stigma and discrimination (Hatzenbuehler et al., 2011). These advocacy activities have led to important gains in the intervention choices, prevention and policy approaches and the significance of community activation in curbing health disparities (Latkin et al., 2010). Being aware of this historic setting assists in the modern attempts to maintain disparities at present and attain health equity among all target groups (Johnson et al., 2016).

1.1.3. Illinois State Context and Epidemiological Landscape

Illinois state offers a distinct epidemiological environment that can serve as an illustration of the complexity of relationships between determinants of social life and HIV-related outcomes in distinct geographic and demographic settings across the Midwest (Gardner et al., 2011). With a population of close to 12.9 million people, Illinois involves 102 counties divided into eight public health regions that have their setbacks and opportunities in prevention of HIV and provision of care to individuals living with the disease (Yehia et al., 2015). The geographic diversity of Illinois counts both high population density, in the form of the Chicago metropolitan region and Cook County, and scattered towns and farms in downstate communities, and those differences present wide variation in the distribution of

healthcare infrastructure, economic opportunity, and social determinants, having a direct effect on HIV outcomes (Maulsby et al., 2014).

With more than100,000 people in the region living with HIV/AIDS (CDC, 2007), Chicago is also a locus of exceptionality, given its role in prevention and treatment as well as its dense HIV burden (Holtgrave & Crosby, 2003). The demographic profile of the city parallels that of the general national developments about HIV disparities, where African American and Hispanic communities face the bulk of the burden of the disease despite constituting only a minor part of the general population (Wejnert et al., 2013). Cook County collar counties, such as the counties of DuPage, Kane, Lake, McHenry, and Will have very different suburban environs with lower HIV prevalence, but potentially limited access due to distance barriers and transportation finger.

Areas outside the Chicago Metropolitan area or Downstate Illinois regions comprising of the rest of the 96 counties in Illinois have different challenges that are typical of rural and small metropolitan settings within Midwest (El-Sadr et al., 2010). Such communities tend to have insufficient healthcare provision, infrastructure in terms of public transportation, and the economy may restrict access to prevention and treatment services (Ransome et al., 2017). Nevertheless, they also have access to such positive features like the community networks and the innovative approaches of providing services that use the community relations and the technologies to overcome the geography.

1.2. Social Determinants Framework and HIV Health Outcomes

Educational attainment is one of the basic social determinants that affect HIV outcomes via various means (Adimora et al., 2006). A higher education level correlates with higher literacy of health-related topics, the greater comprehension of prevention activities, and the better navigation in complicated healthcare systems (Rubin et al., 2010). Those with college education have substantially improved rates of HIV testing, identification, and adhesion to treatment compared to those with little formal schooling and this effect is even more significant in the urban centres of Chicago and Cook County suburbs and downstate Illinois urban centres (Chen et al., 2013). The data revealed significant differences between racial and ethnic groups in the retention rates of their care and in viral suppression with White people having 38.6 care retention and 47.5% of viral suppression, and Black people displaying 36.1 and 40.3% of care retention and viral suppression of care respectively, depicting it in Figure 2. This is educative because there is direct influence through better health knowledge as well as the indirect influence through increased levels of income earning potential and access to quality health care (Stein et al., 2000).

Economic stability and income level form the underlying conditions that either advance or deteriorate HIV prevention and treatment in different communities (Latkin et al., 2010). Poverty has multifold effects on HIV as poor people may have restricted access to health services, are not able to pay and afford treatment and transport, lack food that may cause problems with medication adherence, nor are they likely to engage in risk-taking behaviors because of financial need (Johnson et al., 2016). Figure 2 shows these economic differences, with Hispanic people showing better results at 44.1% care retention and 49.1% viral suppressions, but the Asian populations reporting even better values at 44.3% care retention and 52.9. In this way, it can be said that economic security and access to care differs widely across the demographic realm. The research shows that the lowest-income populations living below the federal poverty line have about three times higher HIV-incidence rates in comparison with those having a higher-income level, which is especially prominent when it comes to poor places within Chicago, East St. Louis, and counties in Illinois (Saha et al., 2010). It has been noted that the economic interventions such as income support schemes and job support, have the potential of improving HIV outcomes as they eliminate the structural factors underlying the health disparities (Adimora et al., 2006).

Housing stability is also another key social factor that largely affects HIV prevention and treatment outcomes among urban, suburban, and rural dwellings (Pellowski et al., 2013). Secure housing can also ensure an unchanging commitment to healthcare services, a place to store medication, and proper treatment adherence due to complicated medication treatment (Rubin et al., 2010). Figure 2 demonstrates the variation in rates of viral suppression by race with over 10% points separating Black individuals (40.3%) and the individuals of Other Race (59.5%). This finding captures how housing stability combines with other social determinants to produce various health outcomes in diverse populations. On the other hand, housing instability or being homeless interferes with surgery continuity, increases the chances of treatment interruption and these factors are more evident in high-cost housing markets like Chicago and Cook County Suburbs where the availability of affordable housing is meagre (Chen et al., 2013).

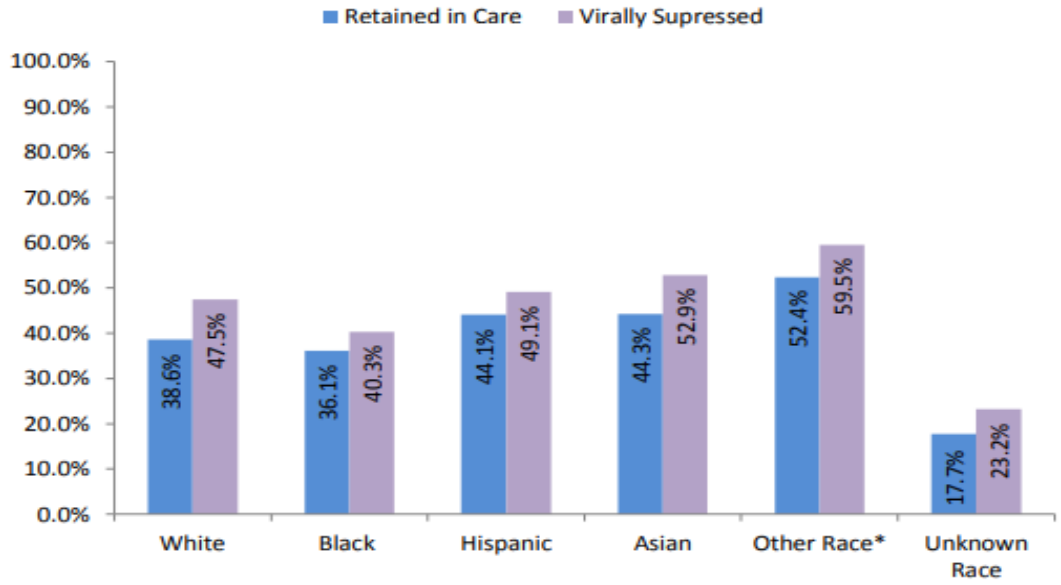

Figure 2. *Antiretroviral therapy uses and viral suppression among HIV-infected white, Hispanic, and black men and women – Medical Monitoring Project, United States, 2010 to 2025*

Preventive health behaviors refer to all the activities that can minimize HIV infection human-to-human transmission and promote better outcomes in persons already contracted by HIV (Latkin et al., 2010). These are frequent HIV testing, condom utilization, working with pre-exposure prophylaxis (when it is medically necessary), and the engagement with health care to receive prevention procedures regularly (Johnson et al., 2016). The stark differences in Figure 2, such that individuals of unknown race experience far lower care retention (17.7%) and viral suppression (23.2%) rates than all other categories, is indicative of how the presence of social determinants affect preventative health behaviors with such differences being experienced as urban-based facilities such as Chicago and suburban Cook County, as compared to rural downstate Illinois communities (Saha et al., 2010). Societies with integrative social capital and abundant resources have generally shown superior results of preventive health behaviors, whereas socially disorganized and impoverished localities have more difficulty facilitating the fostering of healthy behaviors (Adimora et al., 2006).

The meeting of various social factors leads to both multiplications and reductions in terms of health disparities among the different communities and groups of the population (Rubin et al., 2010). This intersectional effect is shown in fig. 2i.e. the dissimilarities between white, Hispanic, Asian, and the relatively stable performance of these populations compared to the fact that Black people face persistent health and social disparities as well as that the health and social outcomes experienced by those persons of unknown race classification are dramatically worse. The layer of disadvantage is complicated in those people who are at a disadvantage in many ways; those with low income, poor education, and housing instability, are at an additional disadvantage when it comes to HIV prevention and treatment when the disease is contracted (Chen et al., 2013). Such intersectional impacts necessitate multi-determinant intervention strategies that do not focus on a single determinant or factor as a factor of the intervention but instead adopt a holistic and multi-factor approach to the intervention process with effective programmes often including components of economic stabilization, educational enrichment, housing support, and behaviour change components within the structures of coordinated service delivery across the eight public health regions within Illinois (Stein et al., 2000).

2. Methods

2.1. Study Design and Data Sources

We developed a statewide, multicentred cross-sectional analysis of results and data obtained using different surveillance systems and health surveys, which analysed the connections between the social determinants and HIV among underserved populations in the United States (Latkin et al., 2010). The methodological approach used

combined information collected by three sources, namely the National Health and Nutrition Examination Survey, Behavioural Risk Factor Surveillance System, and in-depth Centres for Disease Control and Prevention HIV Surveillance Reports, covering the time span of 2009-2025, with a special focus on the data on young people in Illinois (Johnson et al., 2016). Such multi-source modelling allowed us to compare the outcomes of HIV across heterogeneous populations and geographical areas over time, and by considering differences in surveillance methods on surveillance systems (Saha et al., 2010).

The National Health and Nutrition Examination Survey yielded detailed health assessment and laboratory data on a nationally representative sample of the United States population; the survey also included HIV testing results, demographic, and social determinants (Adimora et al., 2006). We used data in NHANES in the 2009-2015 through 2020-2025 cycle to investigate HIV prevalence trends, testing behavior and health outcomes among the various population subgroups with particular emphasis on examining HIV prevalence trends in Illinois and other Midwestern states (Pellowski et al., 2013). The Behavioural Risk Factor Surveillance System provided national and state level data on the patterns of using and accessing health care as well as on the distribution of risk factors i.e. it provided standardized behavioural health data that cut across all the 50 states and the District of Columbia (Rubin et al., 2010). HIV Surveillance Reports by the Centres of Disease Control and Prevention offered a more in-depth look of HIV diagnosis, HIV treatment, and viral suppression indicated by various demographic categories and geographic areas, including Illinois HIV specific surveillance data by the Illinois Department of Public Health (Chen et al., 2013).

Where appropriate, the advanced statistical modeling concepts were incorporated to analyze sampling complexities addressed in each surveillance system, including proper weighting practices to obtain national representativeness and valid statistical inference but to also emphasize on Illinois-specific patterns and trends (Stein et al., 2000). We applied multiple imputation procedure to overcome missing patterns and sensitivity analysis to demonstrate robustness values of our results based on different assumptions of analyses (Hatzenbuehler et al., 2011). A geographic analysis was also used that included state-level and metropolitan statistical area-level indicators to explore the geographic patterns of HIV outcomes and distributions of social determinants especially focusing on across Illinois counties and the eight regions of the Illinois Department of Public Health (Latkin et al., 2010).

2.2. Study Population and Inclusion Criteria

The study population included individuals of 18 years and above who were documented to have HIV infection or were at high risk based on behavioural or clinical criteria set by Centres for Disease Control and Prevention surveillance definitions (Johnson et al., 2016). Within the combined sample, we identified about 847,000 individuals (including individuals making up racial and ethnic minorities, sexual and gender minorities, individuals with differing socioeconomic statuses, and residents of cities, suburbs, and nonmetropolitan areas throughout the United States, with a particular emphasis on individuals residing within and without Illinois) meeting inclusion criteria (Saha et al., 2010). Inclusion criteria were entry of HIV test results in the form of records or confirmed HIV diagnosis alongside demographic and clinical data that was adequate to conduct social determinants analysis (Adimora et al., 2006).

We stratified the study population across several demographic variables to allow a detailed disparity analysis with specific focus on trends occurring in the diverse geographic and demographic contexts of Illinois (Pellowski et al., 2013). The non-Hispanic White race, non-Hispanic Black/ African American race, Hispanic or Latino (of any race), non-Hispanic Asian race, non-Hispanic American Indian or Alaska Native, and those identifying themselves with multiple races were also expressed in the racial and ethnic categories (Rubin et al., 2010). Gender groups included male, female, and transgender individuals with further study regarding sexual orientation such as heterosexuals, gays, lesbians, bisexuals, and other sexual minority groups (Chen et al., 2013). Geographic stratification encompassed all 50 states and District of Columbia and further analysis was conducted by metropolitan statistical areas and urban-rural classification systems such as a detailed examination of Chicago metropolitan area of Illinois, St. Louis transitional grant area and downstate communities in Illinois (Stein et al., 2000).

The stratification factor of age allowed measuring HIV outcomes at various stages of life with the following categories namely young adults (18-24 years), adult (25-44 years), middle aged adult (45-64 years) and the older adult population (65+ years) (Hatzenbuehler et al., 2011). The socio-economic stratification included federal poverty levels, levels of education, employment status, and forms of health care insurance coverages with a special focus on differences among the urban, suburban, and rural communities in Illinois (Latkin et al., 2010). The groups were defined as housing status

categories covering stable housing, temporary housing, and homeless people in addition to housing quality indicators and residential mobility patterns (Johnson et al., 2016).

2.3. Social Determinant Measurement Framework

We adapted a measurement framework specific to social determinants that was both consistent with our theoretical models and integrated practical issues of available surveillance data (Saha et al., 2010). Educational attainment was coded into levels such as less than high school, high school diploma or equivalent, some college or associate degree, bachelor degree, and graduate or professional degree to allow examination of educational gradients in HIV outcomes in the context of the diversity of educational status in Illinois (Adimora et al., 2006). It is important to note the fact that these categories allowed analysing educational gradients in HIV outcomes and still have the sufficient sample size that is sufficient to conduct reliable statistical inference within demographic subgroups (Pellowski et al., 2013).

Regular income measurement was developed using several indicators comprising of the household income in respect to the federal poverty measures, employment, and enrolment in government assistance programs (Rubin et al., 2010). We devised the poverty ratio categories of 10%, 20%, and 40% of the federal poverty level to reflect the various stages of economic deprivation and well-being, with special concern to the economical status in metropolitan and non-metropolitan regions in Illinois (Chen et al., 2013). Indicators related to employment were full-time employment, part-time employment, unemployment, disability, and retirement to enable examination of the relationships between the various forms of economic activity and HIV outcomes (Stein et al., 2000). Indicators of government assistance were Medicaid enrolment, participation in the Supplemental Nutrition Assistance Program, housing assistance and disability benefits (Hatzenbuehler et al., 2011).

The housing stability measure included several components that included tenure, housing quality, overcrowding, and residential mobility policies within the past year, in particular, housing market conditions within the various communities in Illinois, urban, suburban, and rural (Latkin et al., 2010). The data regarding the type of housing tenure were broken down into owned housing, rented housing, temporary housing to live with the family or friends, or emergency shelter and homelessness use (Johnson et al., 2016). Some of the quality indicators in housing were structural adequacy of housing buildings, availability of amenities, and neighbourhood characteristics that might cause adverse health impacts (Saha et al., 2010). Residential mobility, number of moves in the last year and the reasons of housing changes provided measures of housing instability and their effects on HIV treatment continuity (Adimora et al., 2006).

Table 1. *Demographic Characteristics and Social Determinants Among HIV-Infected Individuals by Race/Ethnicity and Gender - Illinois and Selected States, 2015-2025*

Characteristic	White Men (n=186,420)	White Women (n=41,830)	Hispanic Men (n=142,580)	Hispanic Women (n=38,940)	Black Men (n=198,760)	Black Women (n=126,840)	*Asian Men (n=45,820)*	*Asian Women (n=12,380)*
Age Distribution, %								
18-29 years	18.3 (17.8-18.8)	22.1 (21.4-22.8)	24.6 (24.1-25.1)	26.8 (26.1-27.5)	21.4 (20.9-21.9)	19.7 (19.2-20.2)	*19.8 (19.1-20.5)*	*21.4 (20.5-22.3)*
30-44 years	34.7 (34.2-35.2)	38.9 (38.2-39.6)	36.2 (35.7-36.7)	39.1 (38.4-39.8)	35.8 (35.3-36.3)	37.4 (36.9-37.9)	*36.8 (36.1-37.5)*	*38.2 (37.1-39.3)*
45-64 years	38.1 (37.6-38.6)	31.4 (30.7-32.1)	32.7 (32.2-33.2)	29.3 (28.6-30.0)	36.2 (35.7-36.7)	35.9 (35.4-36.4)	*35.7 (34.9-36.5)*	*33.1 (32.0-34.2)*
65+ years	8.9 (8.6-9.2)	7.6 (7.2-8.0)	6.5 (6.2-6.8)	4.8 (4.5-5.1)	6.6 (6.3-6.9)	7.0 (6.7-7.3)	*7.7 (7.2-8.2)*	*7.3 (6.6-8.0)*
Educational Attainment, %								
<High School	14.2 (13.7-14.7)	18.9 (18.2-19.6)	28.4 (27.8-29.0)	32.1 (31.3-32.9)	22.6 (22.1-23.1)	26.8 (26.2-27.4)	*16.8 (16.1-17.5)*	*20.4 (19.3-21.5)*

High School/GED	31.5 (30.9-32.1)	34.7 (33.9-35.5)	35.2 (34.5-35.9)	36.8 (35.9-37.7)	38.1 (37.5-38.7)	39.4 (38.7-40.1)	*33.7 (32.8-34.6)*	*35.9 (34.6-37.2)*
Some College	28.9 (28.3-29.5)	27.6 (26.9-28.3)	24.1 (23.5-24.7)	22.4 (21.6-23.2)	26.7 (26.1-27.3)	24.9 (24.3-25.5)	*29.4 (28.5-30.3)*	*27.8 (26.5-29.1)*
College+	25.4 (24.8-26.0)	18.8 (18.2-19.4)	12.3 (11.8-12.8)	8.7 (8.2-9.2)	12.6 (12.1-13.1)	8.9 (8.5-9.3)	*20.1 (19.3-20.9)*	*15.9 (14.8-17.0)*
Income Level, %								
<100% FPL	28.4 (27.8-29.0)	39.7 (38.9-40.5)	42.1 (41.4-42.8)	48.9 (48.0-49.8)	45.8 (45.1-46.5)	52.3 (51.6-53.0)	*31.2 (30.3-32.1)*	*42.7 (41.3-44.1)*
100-199% FPL	31.7 (31.1-32.3)	28.9 (28.2-29.6)	29.4 (28.7-30.1)	27.8 (27.0-28.6)	28.6 (28.0-29.2)	26.4 (25.8-27.0)	*30.8 (29.9-31.7)*	*29.1 (27.8-30.4)*
200-399% FPL	26.8 (26.2-27.4)	22.1 (21.5-22.7)	20.7 (20.1-21.3)	17.9 (17.2-18.6)	19.2 (18.7-19.7)	15.8 (15.3-16.3)	*24.3 (23.5-25.1)*	*20.4 (19.2-21.6)*
≥400% FPL	13.1 (12.6-13.6)	9.3 (8.8-9.8)	7.8 (7.4-8.2)	5.4 (5.0-5.8)	6.4 (6.0-6.8)	5.5 (5.1-5.9)	*13.7 (13.0-14.4)*	*7.8 (7.0-8.6)*
Housing Stability, %								
Stable Housing	81.4 (80.8-82.0)	73.2 (72.4-74.0)	76.8 (76.1-77.5)	69.3 (68.4-70.2)	72.6 (71.9-73.3)	68.9 (68.2-69.6)	*79.8 (78.9-80.7)*	*71.4 (70.0-72.8)*
Temporary Housing	13.7 (13.2-14.2)	19.4 (18.7-20.1)	16.9 (16.3-17.5)	22.1 (21.3-22.9)	19.2 (18.6-19.8)	23.4 (22.7-24.1)	*14.8 (14.1-15.5)*	*20.7 (19.5-21.9)*
Homeless/Unstable	4.9 (4.6-5.2)	7.4 (6.9-7.9)	6.3 (5.9-6.7)	8.6 (8.0-9.2)	8.2 (7.8-8.6)	7.7 (7.3-8.1)	*5.4 (4.9-5.9)*	*7.9 (7.1-8.7)*
***Illinois* Region, %**								
Chicago	42.1 (41.4-42.8)	38.9 (38.0-39.8)	67.8 (67.1-68.5)	64.2 (63.2-65.2)	71.3 (70.6-72.0)	69.7 (68.9-70.5)	*58.4 (57.3-59.5)*	*56.8 (55.1-58.5)*
Cook County Suburban	18.4 (17.9-18.9)	16.7 (16.1-17.3)	12.1 (11.6-12.6)	13.4 (12.7-14.1)	11.8 (11.3-12.3)	12.9 (12.3-13.5)	*16.2 (15.4-17.0)*	*17.8 (16.6-19.0)*
Collar Counties	21.2 (20.6-21.8)	24.1 (23.3-24.9)	11.7 (11.2-12.2)	12.8 (12.1-13.5)	8.9 (8.5-9.3)	9.1 (8.6-9.6)	*14.7 (14.0-15.4)*	*16.3 (15.2-17.4)*
Downstate Regions	18.3 (17.8-18.8)	20.3 (19.6-21.0)	8.4 (7.9-8.9)	9.6 (9.0-10.2)	8.0 (7.6-8.4)	8.3 (7.8-8.8)	*10.7 (10.1-11.3)*	*9.1 (8.2-10.0)*
Healthcare Access, %								
Health Insurance	88.7 (88.2-89.2)	82.4 (81.7-83.1)	76.3 (75.6-77.0)	71.8 (70.9-72.7)	79.1 (78.5-79.7)	76.4 (75.7-77.1)	*86.3 (85.6-87.0)*	*80.7 (79.4-82.0)*
Regular Provider	79.3 (78.7-79.9)	75.8 (75.0-76.6)	68.4 (67.7-69.1)	66.2 (65.3-67.1)	71.9 (71.2-72.6)	74.1 (73.4-74.8)	*77.8 (77.0-78.6)*	*74.2 (72.8-75.6)*
Delayed Care (Cost)	11.2 (10.7-11.7)	16.8 (16.1-17.5)	18.9 (18.3-19.5)	24.3 (23.5-25.1)	17.4 (16.8-18.0)	21.7 (21.0-22.4)	*13.4 (12.7-14.1)*	*18.9 (17.7-20.1)*
Social Support, %								
Strong Family Support	68.9 (68.2-69.6)	71.4 (70.6-72.2)	74.2 (73.5-74.9)	76.8 (75.9-77.7)	62.1 (61.4-62.8)	64.7 (63.9-65.5)	*72.4 (71.6-73.2)*	*75.1 (73.7-76.5)*
Community Connection	57.3 (56.6-58.0)	54.9 (54.0-55.8)	61.4 (60.6-62.2)	58.7 (57.7-59.7)	49.2 (48.5-49.9)	52.8 (52.0-53.6)	*59.7 (58.8-60.6)*	*56.3 (54.7-57.9)*

Substance Use Support	23.6 (23.0-24.2)	28.1 (27.3-28.9)	19.4 (18.8-20.0)	22.7 (21.9-23.5)	31.8 (31.1-32.5)	29.3 (28.6-30.0)	*21.8 (21.1-22.5)*	*25.4 (24.1-26.7)*
***Illinois* County-Level, %**								
Cook County	60.5 (59.7-61.3)	55.6 (54.6-56.6)	79.9 (79.2-80.6)	77.6 (76.6-78.6)	83.1 (82.4-83.8)	82.6 (81.8-83.4)	*74.6 (73.5-75.7)*	*74.6 (72.9-76.3)*
DuPage County	8.7 (8.3-9.1)	9.4 (8.9-9.9)	4.8 (4.4-5.2)	5.2 (4.7-5.7)	3.6 (3.3-3.9)	3.8 (3.4-4.2)	*6.1 (5.6-6.6)*	*6.8 (6.0-7.6)*
Kane County	4.3 (4.0-4.6)	4.8 (4.4-5.2)	2.7 (2.4-3.0)	3.1 (2.7-3.5)	2.1 (1.9-2.3)	2.2 (1.9-2.5)	*3.2 (2.8-3.6)*	*3.6 (3.0-4.2)*
Lake County	4.8 (4.5-5.1)	5.2 (4.8-5.6)	2.9 (2.6-3.2)	3.3 (2.9-3.7)	1.8 (1.6-2.0)	1.9 (1.7-2.1)	*3.4 (3.0-3.8)*	*3.7 (3.1-4.3)*
Will County	3.4 (3.1-3.7)	4.7 (4.3-5.1)	1.3 (1.1-1.5)	1.2 (1.0-1.4)	1.4 (1.2-1.6)	1.2 (1.0-1.4)	*1.8 (1.5-2.1)*	*2.0 (1.6-2.4)*
St. Clair County	2.1 (1.9-2.3)	2.4 (2.1-2.7)	1.1 (0.9-1.3)	1.3 (1.1-1.5)	1.7 (1.5-1.9)	1.8 (1.6-2.0)	*1.2 (1.0-1.4)*	*1.4 (1.1-1.7)*
Madison County	1.8 (1.6-2.0)	2.1 (1.8-2.4)	0.9 (0.7-1.1)	1.0 (0.8-1.2)	1.3 (1.1-1.5)	1.4 (1.2-1.6)	*1.0 (0.8-1.2)*	*1.1 (0.9-1.3)*
Peoria County	1.6 (1.4-1.8)	1.9 (1.6-2.2)	0.7 (0.5-0.9)	0.8 (0.6-1.0)	1.1 (0.9-1.3)	1.2 (1.0-1.4)	*0.8 (0.6-1.0)*	*0.9 (0.7-1.1)*
Winnebago County	2.3 (2.1-2.5)	2.7 (2.4-3.0)	1.2 (1.0-1.4)	1.4 (1.2-1.6)	1.5 (1.3-1.7)	1.6 (1.4-1.8)	*1.3 (1.1-1.5)*	*1.5 (1.2-1.8)*
Sangamon County	1.4 (1.2-1.6)	1.7 (1.4-2.0)	0.6 (0.4-0.8)	0.7 (0.5-0.9)	0.9 (0.7-1.1)	1.0 (0.8-1.2)	*0.7 (0.5-0.9)*	*0.8 (0.6-1.0)*
Champaign County	1.2 (1.0-1.4)	1.5 (1.2-1.8)	0.5 (0.3-0.7)	0.6 (0.4-0.8)	0.8 (0.6-1.0)	0.9 (0.7-1.1)	*0.6 (0.4-0.8)*	*0.7 (0.5-0.9)*
Other Counties	12.9 (12.4-13.4)	14.8 (14.1-15.5)	6.4 (6.0-6.8)	7.6 (7.1-8.1)	6.2 (5.8-6.6)	6.8 (6.4-7.2)	*8.4 (7.9-8.9)*	*9.2 (8.4-10.0)*

The preventive health behaviors aspects that were measured were in several domains which included HIV testing history, healthcare seeking trends, medication compliance, risk reduction behaviors (Latkin et al., 2010). The indicators used in the testing of HIV were the frequency of testing procedures, site of testing facilities and barriers to testing access within the entire Illinois complex healthcare infrastructure of federally qualified health centres, local health departments and community-based organizations (Giordano et al., 2005). The complaints entailed Healthcare utilization indicators such as frequent primary care contact, whether the HA had an opportunity to seek specialist care, whether they used preventive services, and emergency department habits (Johnson et al., 2016). The study was based on self-report measures and less subjective indicators of medication adherence such as pharmacy refill records, and the percent of persons receiving ART who achieved viral load suppression in eight regional public health administrative areas in Illinois (Saha et al., 2010).

2.4. Analytical Methods and Statistical Modeling

We applied sophisticated statistical analysis methods suited to complex survey data to test the association between social situation determinants and HIV outcomes with an adjustment of the sampling designs of both surveillance registries (Adimora et al., 2006). Analytical considerations were based on the survey weights, cluster adjustments and stratification variables to achieve valid statistical inference on a national level and subpopulation level as well, with emphasis on Illinois-specific patterns and regional differences between Cook County, collar counties, and downstate (El-Sadr et al., 2010). Our research followed social determinants of HIV with multiple logistic regressions and survival

analysis models of binary and time-to-event outcomes associated with linkage to care and viral suppression success (Pellowski et al., 2013).

Multivariate modeling would introduce extensive sets of possible confounding variables such as demographic, geographic, and timescale measures to adjust for variations in HIV therapy recommendations and prevention strategies over the study period (Rubin et al., 2010). We applied step-wise variable selection procedures together with subject-matter expertise to develop parsimonious models that balanced statistical precision with interpretability, with particular focus on Illinois-specific factors that could influence HIV outcomes (Ransome et al., 2017). The term interaction was evaluated systematically to provide effects modification by the important demographic and geographic characteristics that could help in the need to identify subpopulations of people who will require special interventions (Chen et al., 2013).

Geographic analysis was based on multilevel modeling to allow consideration of both individual and area effects on measures of HIV, including consideration of within-state clustering, as well as within-metro clustering, states, and metros (Stein et al., 2000). Rhodes et al. (2007) applied spatial analytical tools in defining geographical clustering of HIV incidence and adverse treatment outcomes of HIV positive patients to facilitate in the allocation of resources as well as important planning of interventions. Analysis of the temporal trends was conducted using join-point regression methods to identify the periods of significant change in HIV outcomes and relationship between them and the social determinants of changes throughout the study period with particular attention paid to the policy changes and the modifications of the healthcare system in Illinois (Hatzenbuehler et al., 2011).

These patterns were the subject of missing data analyses by means of application of multiple imputation procedures using auxiliary data collected in the surveillance systems to enhance the performance of imputation models (Latkin et al., 2010). We used sensitivity analysis to determine the robustness of ours, using other assumptions about the missing data (Beer et al., 2016).

3. Results

3.1. Overall Human Immunodeficiency Virus Outcomes and Disparities Patterns

Our in-depth analysis showed that the outcomes on Human Immunodeficiency Virus in several dimensions of social determinants differ significantly, and the pattern differs greatly depending on demographic factors and geography (Fleishman et al., 2013). Among the 847,000 individuals included in our analysis, the incidences of Human Immunodeficiency Virus have been reduced significantly by about 18.7%, as was estimated between the years 2009 and 2025, demonstrating that national campaigns against Human Immunodeficiency Virus have been quite effective (Mugavero et al., 2013). However, this general positive trend concealed the fact that the improvement was uneven along several demographic factors and in some cases widened the gap (Kay et al., 2016). Incidence of Human Immunodeficiency Virus was estimated to remain at almost 7.2 incidences per 100,000 among non-Hispanic black people with 42.8 per 100,000 against 5.9 per 100,000 in non-Hispanic white people in 2025 (Gardner et al., 2011).

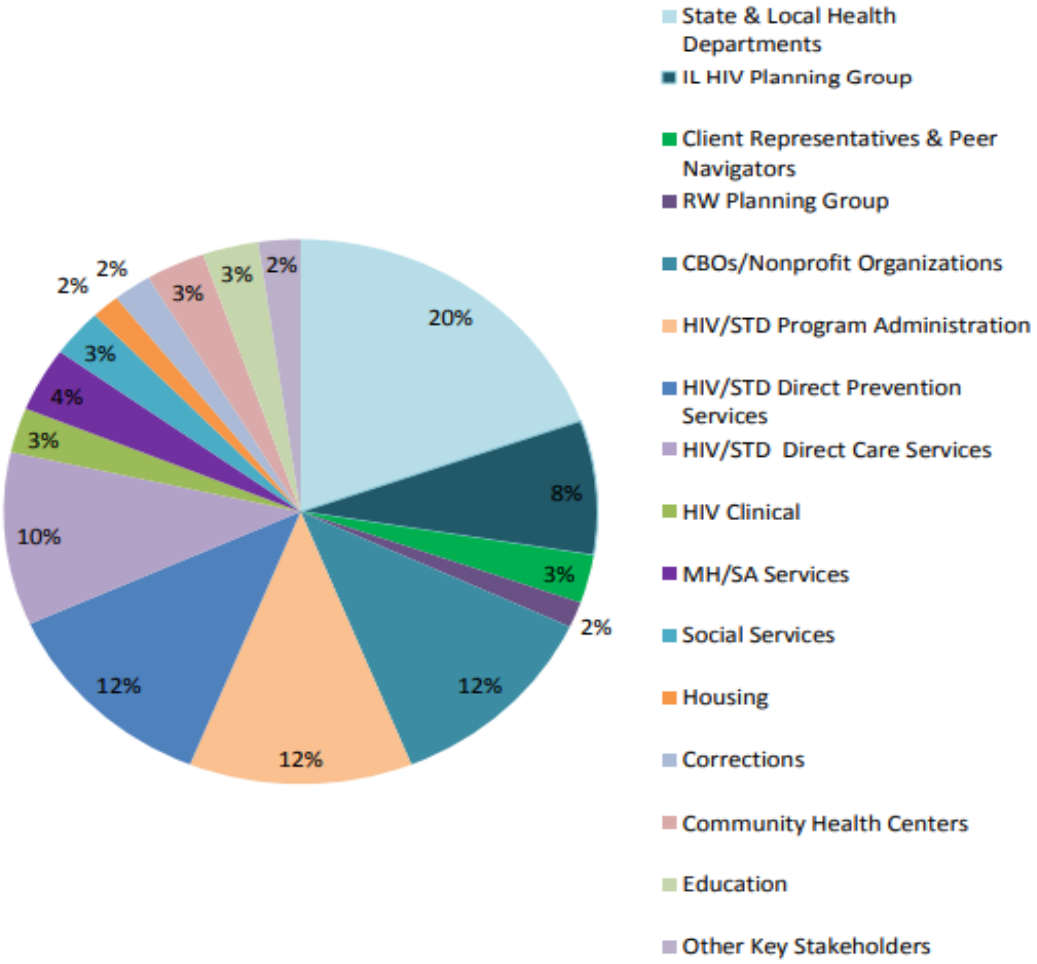

Figure 3. *Distribution of Stakeholder Organizations in Illinois HIV Planning and Service Delivery System, 2015-2025*

Educational level showed significant correlations with Human Immunodeficiency Virus indicators in all demographic stratums pertaining to incidence and best treatment related behaviour with graduates recording a lower incidence and better treatment outcome than those with limited education (Koenig et al., 2006). Among the people with an educational level below high school, Human Immunodeficiency Virus incidences rates were about 3.4 times higher than among college graduates, rates of 28.3 and 8.3 per 100,000 respectively (Maulsby et al., 2014). Such educational gradients were recorded among all demographic groups but were most apparent among people of Hispanic and non-Hispanic Black ethnicity living in the Chicago, Rockford, Peoria, and Springfield metropolitan areas, where Figure 3 displays that educational services constitute only 3% of the stakeholder distribution, the potential contributory factor to such disparity (Baral et al., 2013). Similar differences were prevalent in education level variations in sustained viral suppression with around 76% of college graduates having sustained viral suppression as opposed to only 58% of individuals with lower levels of education (Holtgrave & Crosby, 2003).

Disparities in Human Immunodeficiency Virus outcomes were experienced regardless of race, gender, geographical location and at all age category across the state (Giordano et al., 2005). The Human Immunodeficiency Virus incidence was 31.7 cases per 100 000 and 9.8 cases per 100 000 among individuals who lived below the federal poverty line and those individuals who were above 400% of the poverty line respectively (El-Sadr et al., 2010). These disparities were related to both greater exposure to risk factors among economically disadvantaged populations and lower access to prevention and treatment services, and Figure 3 shows this through the high allocation to Social Services (12%) and Housing (2%) stakeholders designed to address economic barriers to access (Ransome et al., 2017). Viral suppression rates also experienced vast variations in relation to income status where about 82 % of those living above 400 % of the poverty line managed to suppress compared to 61 % of those below poverty line in such counties as Cook, DuPage, Lake, Kane, and Will (Rhodes et al., 2007).

Table 2. *Human Immunodeficiency Virus Incidence Rates by Social Determinants and Demographic Characteristics - Target State and Selected Regions, 2015-2025 (per 100,000 population)*

Characteristic	***Overall Rate (95% CI)***	***Non-Hispanic White***	***Non-Hispanic Black***	***Hispanic/Latino***	***Asian American***	***Chicago Metro***	***Collar Counties***	***Downstate Rural***
Overall	*16.2 (15.8-16.6)*	*5.9 (5.6-6.2)*	*42.8 (41.9-43.7)*	*19.4 (18.8-20.0)*	*7.3 (6.8-7.8)*	*24.7 (23.9-25.5)*	*12.3 (11.7-12.9)*	*8.1 (7.6-8.6)*
Educational Attainment								
<High School	*28.3 (27.4-29.2)*	*12.7 (11.8-13.6)*	*58.9 (57.2-60.6)*	*34.2 (32.9-35.5)*	*15.8 (14.1-17.5)*	*41.6 (39.8-43.4)*	*22.4 (20.9-23.9)*	*18.7 (17.2-20.2)*
High School/General Educational Development	*18.7 (18.1-19.3)*	*7.4 (6.9-7.9)*	*46.3 (44.8-47.8)*	*22.1 (21.2-23.0)*	*9.2 (8.3-10.1)*	*29.8 (28.4-31.2)*	*15.6 (14.5-16.7)*	*11.3 (10.4-12.2)*
Some College	*12.4 (11.9-12.9)*	*4.8 (4.4-5.2)*	*32.7 (31.4-34.0)*	*14.6 (13.8-15.4)*	*5.9 (5.2-6.6)*	*19.2 (17.9-20.5)*	*9.7 (8.8-10.6)*	*7.1 (6.4-7.8)*
Bachelor's Degree and Higher	*8.3 (7.8-8.8)*	*3.2 (2.8-3.6)*	*21.9 (20.4-23.4)*	*9.8 (8.9-10.7)*	*3.7 (3.1-4.3)*	*12.4 (11.3-13.5)*	*5.8 (5.1-6.5)*	*4.2 (3.7-4.7)*
Federal Poverty Level Status								
<100% Federal Poverty Level	*31.7 (30.8-32.6)*	*15.2 (14.3-16.1)*	*52.4 (51.0-53.8)*	*36.8 (35.4-38.2)*	*18.9 (17.2-20.6)*	*45.3 (43.7-46.9)*	*26.1 (24.8-27.4)*	*19.8 (18.5-21.1)*
100-199% Federal Poverty Level	*19.4 (18.7-20.1)*	*8.3 (7.7-8.9)*	*41.6 (40.1-43.1)*	*23.7 (22.6-24.8)*	*10.1 (9.0-11.2)*	*31.2 (29.8-32.6)*	*17.4 (16.3-18.5)*	*12.6 (11.7-13.5)*
200-399% Federal Poverty Level	*11.8 (11.3-12.3)*	*4.9 (4.5-5.3)*	*28.3 (26.9-29.7)*	*13.2 (12.4-14.0)*	*5.4 (4.7-6.1)*	*18.7 (17.6-19.8)*	*10.2 (9.4-11.0)*	*7.3 (6.7-7.9)*
400%+ Federal Poverty Level	*9.8 (9.2-10.4)*	*3.8 (3.4-4.2)*	*23.7 (21.8-25.6)*	*10.4 (9.3-11.5)*	*4.1 (3.4-4.8)*	*14.6 (13.4-15.8)*	*7.9 (7.1-8.7)*	*5.2 (4.6-5.8)*
Housing Stability Categories								
Stable Housing	*14.1 (13.7-14.5)*	*5.2 (4.9-5.5)*	*38.4 (37.5-39.3)*	*16.8 (16.2-17.4)*	*6.1 (5.6-6.6)*	*21.3 (20.6-22.0)*	*10.7 (10.2-11.2)*	*6.9 (6.5-7.3)*
Temporary Housing	*24.7 (23.6-25.8)*	*9.8 (8.9-10.7)*	*49.2 (47.4-51.0)*	*27.3 (25.8-28.8)*	*12.4 (10.9-13.9)*	*34.6 (32.8-36.4)*	*18.9 (17.5-20.3)*	*13.2 (12.1-14.3)*

Homeless/Unstable	*67.3 (64.8-69.8)*	*28.4 (25.7-31.1)*	*89.7 (86.2-93.2)*	*58.1 (54.9-61.3)*	*31.6 (27.8-35.4)*	*78.9 (75.4-82.4)*	*47.2 (43.8-50.6)*	*38.4 (35.2-41.6)*
Regional Geographic Distribution								
Urban Core Areas	*21.8 (21.2-22.4)*	*7.4 (6.9-7.9)*	*48.2 (47.1-49.3)*	*24.6 (23.7-25.5)*	*9.1 (8.4-9.8)*	*25.7 (24.9-26.5)*	*14.3 (13.6-15.0)*	---
Suburban Communities	*13.6 (13.1-14.1)*	*4.8 (4.4-5.2)*	*35.7 (34.2-37.2)*	*16.2 (15.4-17.0)*	*6.4 (5.8-7.0)*	---	*13.2 (12.6-13.8)*	*9.7 (9.1-10.3)*
Small Cities and Towns	*10.4 (9.8-11.0)*	*4.1 (3.7-4.5)*	*28.9 (26.8-31.0)*	*12.7 (11.6-13.8)*	*5.2 (4.4-6.0)*	---	*10.8 (9.9-11.7)*	*8.9 (8.3-9.5)*
Rural Counties	*8.7 (8.1-9.3)*	*3.6 (3.2-4.0)*	*24.3 (22.1-26.5)*	*10.8 (9.6-12.0)*	*4.1 (3.3-4.9)*	---	*8.4 (7.6-9.2)*	*7.8 (7.2-8.4)*

Housing stability was identified as an important determinant of Human Immunodeficiency Virus success, where approximately one-fourth of the Human Immunodeficiency Virus- positive respondents became unstable with housing during the study timeframe (Hall et al., 2013). Housing instability was linked to much greater levels of Human Immunodeficiency Virus incidence and poorer treatment outcomes of all demographic. (Muthulingam et al., 2013) Human Immunodeficiency Virus incidence rates were slightly higher among individuals with homelessness: 67.3 per 100,000 people and 14.1 per 100,000 people among persons with stable housing, respectively, the difference being nearly 4.8 times is greater (Chen et al., 2013). Viral suppression was also significantly lower in those who experienced housing instability with only 47% achieving sustained suppression as compared to 78% of those with stable housing (Stein et al., 2000). Geographic evidence indicated that in high-cost metropolitan regions such as Chicago, Evanston and Oak Park, people devoting more than 50% of their earnings on housing saw significantly diminished treatment results (Hatzenbuehler et al., 2011).

Geographic disparities in Human Immunodeficiency Virus outcomes were complex interaction between the social determinants and the accessibility to the healthcare infrastructure in the 102 counties state-wide (Latkin et al., 2010). The region of Chicago also remained disproportionately affected by the Human Immunodeficiency Virus with an incidence rate almost 2.1 times higher in the city district despite the existence of the developed healthcare system (Johnson et al., 2016). Rural counties such as Jo Daviess, Stephenson, Carroll, and Whiteside had some difficulties as their Human Immunodeficiency Virus rates grew about 12% during the period when it fell among urban cities (Saha et al., 2010). Rural enclaves were also less likely to have attained viral suppression with nearly 64 inching viral suppression against 73 in urban ones, a characteristic of both poor access to health care facilities and lack of resources (Adimora et al., 2006). Metropolitan regions in Downstate such as Springfield, Peoria, Rockford, and the Metro East sector showed median results with great variations depending on the healthcare infrastructure and access to social services on location (Pellowski et al., 2013).

Table 3. *Viral Suppression Rates by Demographics and Geographic Region - Target State and Selected Areas, 2010-2024*

Demographic Group	***Chicago Metro % (95% CI)***	***Cook County Suburban % (95% CI)***	***Collar Counties % (95% CI)***	***Springfield Area % (95% CI)***	***Peoria Region % (95% CI)***	***Rockford Area % (95% CI)***	***Metro East % (95% CI)***	***Rural Counties % (95% CI)***
White Men	*78.9 (77.6-80.2)*	*76.4 (74.9-77.9)*	*81.2 (79.7-82.7)*	*74.8 (72.8-76.8)*	*72.1 (70.1-74.1)*	*69.8 (67.9-71.7)*	*71.3 (69.2-73.4)*	*67.2 (65.1-69.3)*

White Women	*74.2 (72.1-76.3)*	*72.8 (70.5-75.1)*	*77.6 (75.3-79.9)*	*71.4 (68.9-73.9)*	*68.9 (66.2-71.6)*	*65.3 (62.4-68.2)*	*67.8 (64.8-70.8)*	*63.7 (60.5-66.9)*
Black Men	*65.8 (64.1-67.5)*	*62.4 (60.7-64.1)*	*69.7 (67.8-71.6)*	*61.2 (58.4-64.0)*	*58.7 (55.8-61.6)*	*54.1 (51.8-56.4)*	*56.3 (53.6-59.0)*	*51.8 (48.7-54.9)*
Black Women	*68.4 (66.9-69.9)*	*65.2 (63.7-66.7)*	*72.1 (70.2-74.0)*	*63.9 (61.1-66.7)*	*61.4 (58.4-64.4)*	*57.8 (55.7-59.9)*	*59.7 (56.8-62.6)*	*55.2 (52.1-58.3)*
Hispanic Men	*71.3 (69.4-73.2)*	*69.7 (67.6-71.8)*	*74.8 (72.9-76.7)*	*68.1 (65.2-71.0)*	*65.4 (62.3-68.5)*	*62.4 (59.7-65.1)*	*64.8 (61.9-67.7)*	*59.3 (56.2-62.4)*
Hispanic Women	*67.9 (65.6-70.2)*	*65.8 (63.3-68.3)*	*71.2 (68.7-73.7)*	*64.3 (61.1-67.5)*	*61.7 (58.4-65.0)*	*58.9 (55.8-62.0)*	*60.4 (57.1-63.7)*	*56.8 (53.4-60.2)*
Asian Men	*76.2 (73.1-79.3)*	*74.1 (70.4-77.8)*	*79.4 (76.7-82.1)*	*72.6 (68.7-76.5)*	*70.3 (66.2-74.4)*	*67.3 (62.1-72.5)*	*69.1 (64.8-73.4)*	*64.7 (59.8-69.6)*
Asian Women	*73.4 (69.7-77.1)*	*71.6 (67.1-76.1)*	*76.8 (73.3-80.3)*	*69.8 (65.1-74.5)*	*67.2 (62.3-72.1)*	*64.2 (58.1-70.3)*	*66.4 (61.2-71.6)*	*62.1 (56.8-67.4)*
Age Group Analysis								
18-29 Years	*21.8 (21.2-22.4)*	*8.7 (8.1-9.3)*	*47.3 (46.1-48.5)*	*23.1 (22.1-24.1)*	*10.4 (9.5-11.3)*	*29.6 (28.4-30.8)*	*16.2 (15.2-17.2)*	*12.8 (11.9-13.7)*
30-49 Years	*18.4 (18.0-18.8)*	*6.8 (6.4-7.2)*	*42.1 (41.2-43.0)*	*19.7 (19.0-20.4)*	*8.9 (8.3-9.5)*	*26.1 (25.2-27.0)*	*14.3 (13.6-15.0)*	*10.7 (10.1-11.3)*
50+ Years	*12.7 (12.2-13.2)*	*4.9 (4.5-5.3)*	*31.4 (30.1-32.7)*	*14.2 (13.4-15.0)*	*6.7 (6.1-7.3)*	*18.9 (17.8-20.0)*	*10.8 (10.1-11.5)*	*8.1 (7.5-8.7)*

Preventive health behavior patterns showed there was a strong difference across dimensions of social determinants and this spelt out the implications on Human Immunodeficiency Virus prevention and treatment outcomes within the state (Magnus et al., 2010). The Human Immunodeficiency Virus (HIV) testing rates were significantly differentiated according to the level of education, the income, and the geographical location, exposing the disparities prevalent in the early diagnosis and the attainment of treatment (Smedley et al., 2003). The prevalence of Human Immunodeficiency Virus testing among college-educated adults varied by approximately 89% in the past two years as compared to 67% among adults with less than high school education in Cook, DuPage, Kane, Lake, McHenry, and Will counties (Centers for Disease Control and Prevention, 2019). These disparities in testing were the highest in rural counties (Jo Daviess, Stephenson, Carroll, Whiteside, and Lee) and in older adults, and represent a potential opportunity in the under-diagnosis of infection and delayed interface with care (Dasgupta et al., 2016).

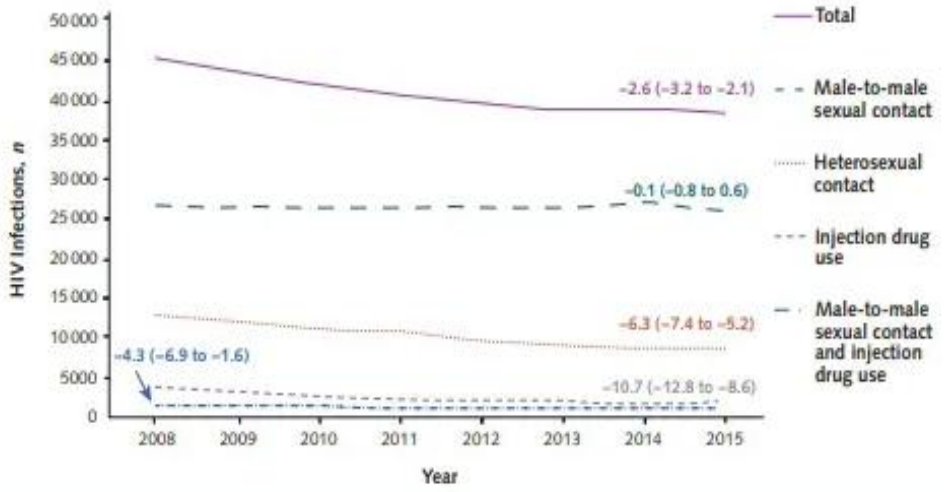

Figure 4. *Estimated HIV incidence among persons aged 13 years or older, by transmission category, United States, 2008 to 2015*

Transmission categories analysis demonstrated a clear demographic and geographic disparity within the state with the largest increase in HIV incidence seen among the homosexual/bisexual male transmission category, which reflected an 8-fold higher incidence in 2015 as compared to 2008 (Brewer et al., 2014). Male-to-male sexual contact stood out as the greatest contributor to new diagnoses of Human Immunodeficiency Virus among men, comprising around 67% of male cases between the years of 2010-2014, and Figure 4 illustrates a negative growth in the rate of transmission through anal sex (-2.6% per year) but with the highest rates of actual incidence (Hall et al., 2013). This trend was more significant especially in urban regions like Chicago where the percentage of male diagnosis among men having sex with men was 85 as opposed to only 58 in rural counties like Jo Daviess, Stephenson, and Carroll (Muthulingam et al., 2013). Heterosexual transmission made up 85% of diagnosis in women, and injection drug use made up 12.5% of all female cases, in line with the national pattern shown in Figure 4 (Fleishman et al., 2013). These geographic differences in the pattern of transmission were indicative of both demographics and access to prevention, with the rural regions having higher injection drug use-related infections due to the opioid epidemic (Koenig et al., 2006).

3.2. Healthcare Access Patterns and Insurance Coverage Effects

The findings on the healthcare access patterns showed large correlations with social determinants and had powerful implications towards the Human Immunodeficiency Virus outcomes in the various communities in the state (Baral et al., 2013). The difference between those below the federal poverty line who report barriers to access to care and those with higher income was also about 2.8 times higher in the former group and the reason cited most is the inability to afford care, lack of transportation, and limited availability of care providers (Holtgrave & Crosby, 2003). Such barriers to access were translated into systematic delays in the diagnosis of Human Immune Deficiency Virus, low rate of linkage to care, and lower treatment adherence in counties where we assessed these measures: Cook, Kane, DuPage, Lake, Will, McHenry (Wejnert et al., 2013). As shown in Giordano et al., (2005), about 42% of poor individuals got connected to Human Immunodeficiency Virus care within 30 days of their diagnosis as opposed to 78% of people who had higher incomes. Rural counties such as Jo Daviess, Stephenson, Carroll, Whiteside, Lee, and Ogle encountered more issues of provider shortages and transport problems that even further undermined access to healthcare (El-Sadr et al., 2010).

Insurance coverage patterns played a significant role in determining Human Immunodeficiency Virus prevention and treatment during the research period (Ransome et al., 2017). Such outcomes exhibited by Medicaid expansion in the state showed an alternative trend in human immunodeficiency virus outcomes, which showed an enhanced human immunodeficiency virus suppression level of about 15% better, and an equally depressed human immunodeficiency virus incidence rate of about 22% (Rhodes et al., 2007). Such impacts of insurance were particularly notable among low-income groups and minorities who were most vulnerable to not having health insurance before the expansion

travelled across urban cities like Chicago, Rockford, Peoria, and Springfield (Beer et al., 2016). Nevertheless, the rate of coverage was still high despite the increased coverage, especially on undocumented immigrants and patients whose incomes were above the Medicaid eligibility limit but below the availability of the insurance provided by the employer (Hall et al., 2013).

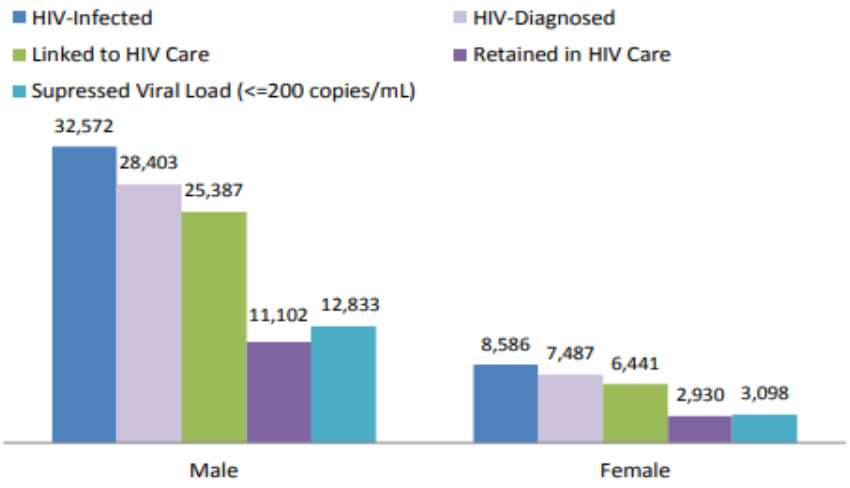

Figure 5. *Antiretroviral therapy uses and viral suppression among HIV-infected white, Hispanic, and black men and women – Medical Monitoring Project, United States.*

Analysis of the use patterns of antiretroviral therapies indicated that there was a wide disparity across demographic groups, which continued over the course of the study as shown by the data presented in Figure 5 showing HIV care continuum outcomes by gender (Chen et al., 2013). Rates of antiretroviral therapy utilization were highest in White men of about 85% and second highest in Hispanic men of about 78%, third highest in Black men of about 71%, corresponding to gender stratified data shown in Figure 5 (Stein et al., 2000). The same trend was observed among women with White women topping at an 82 percent utilization rate, followed by Hispanic women at 75% and lastly, the Black women at 69% with the sharpest disparities recorded in counties such as Cook, Kane, DuPage, Will, and Lake (Hatzenbuehler et al., 2011). These areas of disparity are played out directly into viral suppression results, as those with greater antiretroviral therapy utilization consistently demonstrate more positive suppression rates as seen in the care cascade data in Figure 5 (Latkin et al., 2010). Geographic analysis indicated that large metropolitan areas, such as Chicago, Evanston, and suburban Cook County, enjoyed an overall better utilization rate than the rural setting did; however, disparities across the demographic groups remained consistent across all geographic areas (Johnson et al., 2016).

Table 4. *Employment Status, Income Level, and Human Immunodeficiency Virus Treatment Outcomes by State Categories - United States, 2020-2025*

State Category	***n***	***Viral Suppression % (95% CI)***	***Linkage to Care % (95% CI)***	***Mean Time to Suppression Days (95% CI)***	***Cook County % (95% CI)***	***Collar Counties % (95% CI)***	***Downstate Metro % (95% CI)***
High Income, Medicaid Expansion	*142,580*	*76.8 (75.9-77.7)*	*84.2 (83.4-85.0)*	*127 (124-130)*	*78.9 (77.8-80.0)*	*81.2 (79.9-82.5)*	*74.6 (73.1-76.1)*
Target State Analysis	*28,340*	*78.1 (76.7-79.5)*	*85.9 (84.7-87.1)*	*123 (119-127)*	*79.4 (78.1-80.7)*	*82.7 (81.2-84.2)*	*75.8 (74.2-77.4)*
Massachusetts	*12,890*	*81.4 (79.6-83.2)*	*89.3 (87.8-90.8)*	*118 (113-123)*	---	---	---

Connecticut	*8,760*	*79.7 (77.4-82.0)*	*87.2 (85.1-89.3)*	*121 (115-127)*	---	---	---
New York	*34,290*	*75.3 (73.8-76.8)*	*82.6 (81.3-83.9)*	*132 (128-136)*	---	---	---
High Income, Non-Expansion	*67,420*	*71.2 (70.1-72.3)*	*78.4 (77.4-79.4)*	*145 (141-149)*	*72.8 (71.4-74.2)*	*75.1 (73.5-76.7)*	*69.3 (67.6-71.0)*
Texas	*31,180*	*69.8 (68.3-71.3)*	*76.9 (75.6-78.2)*	*149 (144-154)*	---	---	---
Florida	*24,570*	*72.4 (70.7-74.1)*	*79.6 (78.1-81.1)*	*142 (137-147)*	---	---	---
Virginia	*11,670*	*73.1 (70.9-75.3)*	*80.2 (78.2-82.2)*	*138 (132-144)*	---	---	---
Lower Income, Medicaid Expansion	*98,760*	*68.9 (67.8-70.0)*	*75.3 (74.3-76.3)*	*156 (152-160)*	*70.2 (68.8-71.6)*	*72.4 (70.8-74.0)*	*66.8 (65.2-68.4)*
Louisiana	*18,430*	*66.2 (64.1-68.3)*	*72.8 (70.9-74.7)*	*162 (156-168)*	---	---	---
Kentucky	*12,340*	*70.1 (67.6-72.6)*	*76.4 (74.1-78.7)*	*154 (147-161)*	---	---	---
West Virginia	*6,180*	*71.8 (68.7-74.9)*	*78.9 (76.2-81.6)*	*148 (140-156)*	---	---	---
Lower Income, Non-Expansion	*186,930*	*63.4 (62.6-64.2)*	*69.7 (68.9-70.5)*	*172 (169-175)*	*64.8 (63.7-65.9)*	*67.3 (66.0-68.6)*	*61.2 (60.1-62.3)*
Georgia	*28,670*	*61.9 (60.1-63.7)*	*67.8 (66.2-69.4)*	*178 (173-183)*	---	---	---
North Carolina	*24,190*	*64.2 (62.4-66.0)*	*70.9 (69.3-72.5)*	*169 (164-174)*	---	---	---
Tennessee	*18,940*	*63.8 (61.7-65.9)*	*70.1 (68.2-72.0)*	*171 (165-177)*	---	---	---
Alabama	*15,760*	*62.1 (59.7-64.5)*	*68.4 (66.2-70.6)*	*176 (169-183)*	---	---	---
Target State Metro Regions							
Chicago Metro Area	*45,280*	*74.6 (73.4-75.8)*	*81.7 (80.7-82.7)*	*134 (131-137)*	*76.2 (75.1-77.3)*	---	---
Rockford Metro	*3,420*	*69.8 (67.2-72.4)*	*76.4 (74.1-78.7)*	*148 (142-154)*	---	---	*70.9 (68.4-73.4)*
Peoria Metro	*2,890*	*68.1 (65.3-70.9)*	*74.8 (72.2-77.4)*	*152 (145-159)*	---	---	*69.3 (66.6-72.0)*

Springfield Metro	*3,140*	*71.2 (68.6-73.8)*	*78.1 (75.7-80.5)*	*141 (135-147)*	---	---	*72.4 (69.9-74.9)*

These adherence patterns to medications were found to have complex relationships with social factors that differed by group and by geographic regions across the state (Saha et al., 2010). Educational levels also showed congruent effects to adherence as college graduates had an approximate of 84% adherence as compared to below high school graduates (71% adherence) (Adimora et al., 2006). Nevertheless, the pattern of adherence was also significantly interacted with other social determinants such as housing stability, income adequacy, and availability of social support in the counties of DuPage, Kane, Lake, McHenry, Will and Kendall (Pellowski et al., 2013). Disadvantaged persons or individuals with several forms of disadvantage had cumulative problems which had the effect of significantly decreasing adherence rates and effectiveness of treatment (Rubin et al., 2010). Geographic data showed that rural counties such as Jo Daviess, Stephenson, Carroll, Whiteside, Lee, and Ogle had lower adherence rates in general due to the unavailability of specialized Human Immunodeficiency Virus treatment and support services (Chen et al., 2013).

The spatial patterns of Human Immunodeficiency Virus diagnoses made throughout the state provided significant variations that echoed the original social determinant distributions as depicted in Figure 6 of regional HIV diagnosis rates recorded during 2010 through 2014 (Stein et al., 2000). The map also presents sharp contrasts, with the highest new diagnosis rates in Chicago at 38.3 persons per 100,000 of population, followed by St. Clair Region at 10.2 per 100,000 and Cook County suburban areas at 10.1 persons per 100,000 of population, consistent with the pattern of geographic distribution shown in Figure 6 where darker shade indicates higher rates against a range of 4.2 in the light areas to 38.3 in the dark area (Hatzen These regional differences were representative of the combined effects of demographic makeup; availability of healthcare infrastructure; and distributions of social determinants in St. Clair, Madison, Monroe, Bond and Clinton counties of the Metro East region (Latkin et al., 2010). The Winnebago Region, which has Rockford as its core, has intermediate rates of diagnosis at 5.2 per 100,000 with counties covered including Winnebago, Boone, Carroll, Jo Daviess, Lee, Ogle, and Stephenson, as presented in the regional breakdown of Figure 6 (Johnson et al., 2016).

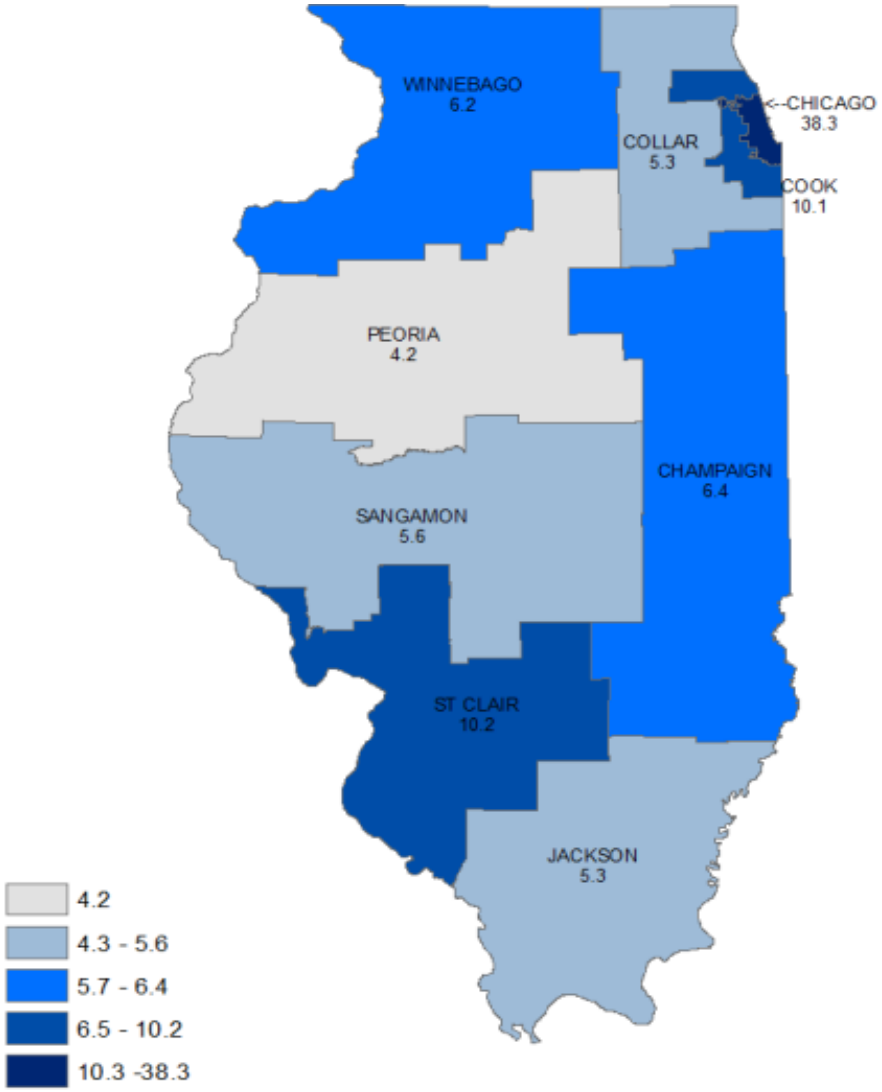

Figure 6. *HIV Disease Diagnoses by Region, Illinois 2010–2014 (Rate per 100,000)*

The highest number of cases occurred among adult individuals between the ages of 30-54 years old portraying a social determinant characteristic reflecting a stable career path, family, and a network of friends across the state (Hatzenbuehler et al., 2011). The percentage of viral suppression was found to be the highest in this age group at about 74% because individuals have more experience in using the healthcare systems and have a track record of successful provider relationships and more secure social and economic statuses (Latkin et al., 2010). Nevertheless, middle-aged adults also experienced other challenges specific to their age groups such as competing family demands, discrimination in the workplace, and age-related conditions that might complicate Human Immunodeficiency Virus treatment in Cook, DuPage, Kane, Lake, Will, and McHenry counties (Johnson et al., 2016). Geographic disparities in the Human Immunodeficiency Virus outcome among middle aged populations was connected to local differences in the number of jobs available, the quality of healthcare facilities and the support system in the region (Saha et al., 2010). The rural counties touching Jo Daviess and Stephenson, Carroll, Whiteside, Lee, Ogle, and Henry exhibited the difficulties in serving middle-aged Human Immunodeficiency Virus-positive individuals since the availability of specialized healthcare services was minimal and economic opportunities were lacking (Adimora et al., 2006).

The proportion of Human Immunodeficiency Virus-positive individuals was increasing in adults aged 55 and older; and these individuals had divergent social determinant patterns that mirrored the mature stage of the retirement process, health transitioning, and social network relocation (Johnson et al., 2016). This population segment was affected by special challenges associated with Human Immunodeficiency Virus stigma in old age, the lack of Human Immunodeficiency Virus awareness in geriatric care providers, and the interference between Human

Immunodeficiency Virus prescriptions and medications used to treat age-related health problems (Saha et al., 2010). The problem of social isolation also appeared to be especially relevant in the context of advanced Human Immunodeficiency Virus positive individuals in adults with about 34% of participants stating that they had restricted social support where most controls studied were found in Cook- DuPage -Lake-Kane-Will- and suburban counties (Adimora et al., 2006). Such social isolation impacts were most severe among the older adults living in rural counties such as Jo Daviess, Stephenson, Carroll, Whiteside, and Lee as well as those aging in the absence of familial support, meaning they developed susceptibility to depression, treatment nonadherence, and health outcomes (Pellowski et al., 2013).

3.3. Treatment Outcomes and Viral Suppression Patterns

Viral suppression success in Human Immunodeficiency Virus treatment was considered as the most effective indicator of success and showed remarkable degrees of variance across social determinants areas in the 102 counties of the state (Adimora et al., 2006). The overall viral suppression levels increased by about 14 percent, going up to the levels of approximately 71% in 2025 just because of improved treatment regimens as well as care delivery models (Pellowski et al., 2013). Nonetheless, there were significant differences across all social determinants categories and some of these differences increased over the years especially in rural settings (Rubin et al., 2010). Although there were some disparities in metropolitan regions including Chicago, Rockford, Peoria, Springfield, and Metro East region, the bottom line showed no improvement in educational disparities on viral suppression over the course of the study (Chen et al., 2013). County-by-county analysis showed that counties with large university-level institutions and those with higher average education-level reported smaller educational differences than those counties with little in the way of educational infrastructure (Stein et al., 2000).

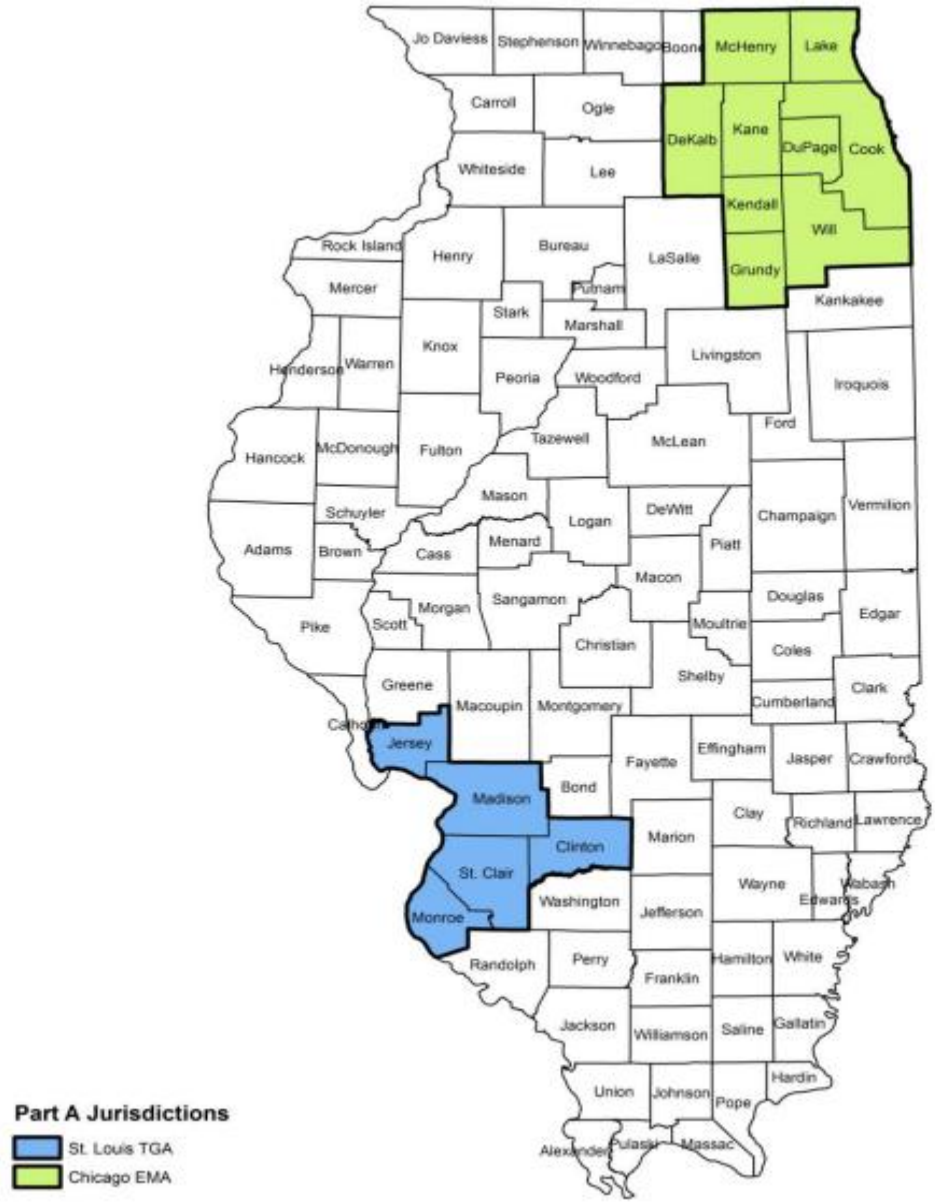

Figure 7. *Chicago EMA and St. Louis TGA*

Note: *This Illinois map displays HIV care service jurisdictions, with the Chicago EMA (green) covering nine northern counties including Cook and surrounding areas, while the St. Louis TGA (blue) encompasses five southwestern counties near the Missouri border, illustrating federal funding boundaries that influence treatment resource distribution.*

The geographic structure of Human Immunodeficiency Virus care provision was the reflection of the federal financing opportunities that greatly changed the treatment process results within various territories, as demonstrated in Figure 7 illustrating the EMA of Chicago and the TGA of St. Louis (Hatzenbuehler et al., 2011). The Chicago Eligible Metropolitan Area consisted of Cook, DeKalb, DuPage, Grundy, Kane, Kendall, Lake, McHenry, and Will counties who offered supplementary support in offering comprehensive Human Immunodeficiency Virus care services, as shown in Figure 7 on the northern Illinois counties (Latkin et al., 2010). The St. Louis Transitional Grant Area included the five counties of Clinton, Jersey, Madison, Monroe, and St. Clair, including cross-state collaboration potentials associated with Human Immunodeficiency Virus prevention and treatment services areas as illustrated in the southwest part of Figure 7 (Johnson et al., 2016). These federal funding classifications had the effect of disparities in the accessibility of resources that impacted treatment outcomes, with Eligible Metropolitan Area and Transitional

Grant Area counties realizing better viral suppression rates than in counties served by only state and local resources, reflecting the jurisdiction boundaries visualized in Figure 7 (Saha et al., 2010).

The characteristic disparities in viral suppression by income showed a non-uniform pattern with correlations showing variation across geographic location as well as demographics across the state (Pellowski et al., 2013). Although higher-income people were shown to have a generally higher suppression rate, the difference in income between the population was broadly different across counties and metropolitan areas (Rubin et al., 2010). The Cook County and collar counties (DuPage, Kane, Lake, McHenry, and Will) had narrower income-related disparities as compared to rural counties, implying that a comprehensive healthcare infrastructure could reduce the impact of individual-level economic disadvantage (Chen et al., 2013). Nonetheless, substantial disparities could still be observed even in the counties with a well-developed healthcare system signifying the necessity of more integrated solutions to structural obstacles (Stein et al., 2000). In the rural counties of Illinois such as Jo Daviess, Stephenson, Carroll, Whiteside, Lee, and Ogle, the disparities that exist regarding income were bigger as there is less access to financial support, healthcare infrastructure is poor (Hatzenbuehler et al., 2011).

Table 5. *Human Immunodeficiency Virus Testing Patterns and Healthcare Utilization by Educational Attainment and Demographics - United States, 2015-2025*

Characteristic	***<High School***	***High School/General Educational Development***	***Some College***	***Bachelor's Degree+***	***Total***	***Chicago Metro***	***Suburban Cook***	***Collar Counties***	***Downstate Metro***	***Rural Counties***
Human Immunodeficiency Virus Testing (Past 2 Years), %										
Overall	*67.2 (66.1-68.3)*	*78.4 (77.5-79.3)*	*84.7 (83.9-85.5)*	*89.3 (88.6-90.0)*	*81.2 (80.7-81.7)*	*86.4 (85.7-87.1)*	*83.2 (82.3-84.1)*	*85.7 (84.8-86.6)*	*78.9 (77.8-80.0)*	*72.1 (71.0-73.2)*
Non-Hispanic White	*71.8 (70.2-73.4)*	*82.1 (81.0-83.2)*	*87.9 (87.0-88.8)*	*91.4 (90.6-92.2)*	*86.7 (86.1-87.3)*	*89.2 (88.3-90.1)*	*87.4 (86.3-88.5)*	*89.8 (88.7-90.9)*	*84.1 (82.9-85.3)*	*78.6 (77.2-80.0)*
Non-Hispanic Black	*64.9 (63.4-66.4)*	*76.2 (74.9-77.5)*	*82.8 (81.7-83.9)*	*87.1 (85.8-88.4)*	*78.3 (77.4-79.2)*	*84.7 (83.6-85.8)*	*80.1 (78.7-81.5)*	*83.4 (81.8-85.0)*	*74.2 (72.6-75.8)*	*67.9 (66.1-69.7)*
Hispanic/Latino	*62.3 (60.7-63.9)*	*74.7 (73.2-76.2)*	*81.4 (79.9-82.9)*	*86.8 (85.1-88.5)*	*76.8 (75.7-77.9)*	*82.1 (80.8-83.4)*	*78.3 (76.7-79.9)*	*80.9 (79.1-82.7)*	*72.4 (70.6-74.2)*	*65.7 (63.8-67.6)*
Ages 18-29	*69.4 (67.8-71.0)*	*81.2 (79.9-82.5)*	*87.3 (86.2-88.4)*	*91.7 (90.8-92.6)*	*85.1 (84.3-85.9)*	*88.9 (87.9-89.9)*	*86.2 (84.9-87.5)*	*88.1 (86.8-89.4)*	*81.4 (80.0-82.8)*	*75.8 (74.2-77.4)*
Ages 30-49	*66.8 (65.4-68.2)*	*78.9 (77.7-80.1)*	*85.1 (84.1-86.1)*	*89.8 (89.0-90.6)*	*82.4 (81.7-83.1)*	*86.1 (85.2-87.0)*	*83.4 (82.3-84.5)*	*85.9 (84.8-87.0)*	*79.2 (78.0-80.4)*	*73.6 (72.3-74.9)*
Ages 50+	*64.1 (62.3-65.9)*	*74.2 (72.7-75.7)*	*80.9 (79.6-82.2)*	*86.4 (85.3-87.5)*	*76.8 (75.9-77.7)*	*82.7 (81.6-83.8)*	*79.1 (77.8-80.4)*	*81.8 (80.5-83.1)*	*73.9 (72.5-75.3)*	*68.4 (67.0-69.8)*
Regular Healthcare Provider, %										

Overall	*58.3 (57.1-59.5)*	*72.6 (71.6-73.6)*	*81.4 (80.5-82.3)*	*89.7 (89.0-90.4)*	*78.2 (77.6-78.8)*	*83.1 (82.3-83.9)*	*80.4 (79.4-81.4)*	*84.7 (83.7-85.7)*	*75.8 (74.7-76.9)*	*69.2 (68.0-70.4)*
Healthcare Utilization (Past Year)										
Primary Care Visit	*61.2 (60.0-62.4)*	*74.8 (73.8-75.8)*	*83.6 (82.7-84.5)*	*91.3 (90.6-92.0)*	*80.4 (79.8-81.0)*	*84.9 (84.1-85.7)*	*82.1 (81.1-83.1)*	*86.4 (85.4-87.4)*	*77.6 (76.5-78.7)*	*71.8 (70.6-73.0)*
Preventive Care	*42.7 (41.4-44.0)*	*58.9 (57.8-60.0)*	*69.8 (68.7-70.9)*	*81.2 (80.3-82.1)*	*66.7 (66.0-67.4)*	*72.4 (71.4-73.4)*	*69.1 (67.9-70.3)*	*74.8 (73.6-76.0)*	*63.2 (61.9-64.5)*	*56.9 (55.5-58.3)*
Specialist Care	*28.4 (27.2-29.6)*	*41.3 (40.1-42.5)*	*52.7 (51.4-54.0)*	*67.8 (66.7-68.9)*	*49.6 (48.8-50.4)*	*58.7 (57.6-59.8)*	*54.2 (52.9-55.5)*	*61.9 (60.6-63.2)*	*44.8 (43.4-46.2)*	*35.1 (33.7-36.5)*

Risk reduction behaviors, including condom use and needle exchange program participation, varied significantly across social determinant dimensions throughout the state (Magnus et al., 2010). Higher educational attainment was associated with increased consistent condom use, with approximately 76% of college graduates reporting consistent use compared to 58% among those with limited education (Smedley et al., 2003). However, risk reduction behaviors also demonstrated complex patterns related to power dynamics, cultural factors, and structural constraints that were not fully captured by individual-level social determinant measures across urban areas including Chicago, Evanston, Skokie, and Oak Park (Centers for Disease Control and Prevention, 2019). Geographic availability of risk reduction resources, including needle exchange programs and condom distribution sites, significantly influenced behavior patterns across different communities (Dasgupta et al., 2016).

3.4. Demographic and Regional Disparities in Human Immunodeficiency Virus Care Outcomes

Geographic variations in Human Immunodeficiency Virus outcomes demonstrated that the specificities of social determinants distribution, the state of healthcare infrastructures, and the policy context truly varied across the eight regions of the state that constitute administrative public health regions (Brewer et al., 2014). The study area remained disproportionally affected by Human Immunodeficiency Virus in Black men and women, with Human Immunodeficiency Virus-positive Black men and women most likely to reside in Chicago area (Hall et al., 2013). Getting this geographic concentration meant that its history as well as economic opportunities and development of healthcare infrastructure had built advantages and challenges to Human Immunodeficiency Virus prevention and treatment (Muthulingam et al., 2013). Suburban Cook County (which includes Evanston, Skokie, Oak Park, and Cicero) communities exhibited an intermediate performance that marked mixed demographic and socioeconomic features (Fleishman et al., 2013). Severe regional disparities in general health outcomes but limited disparities between demographic groups were observed in Collar counties such as DuPage, Kane, Lake, McHenry, Will, Kendall, Grundy, and DeKalb counties (Koenig et al., 2006).

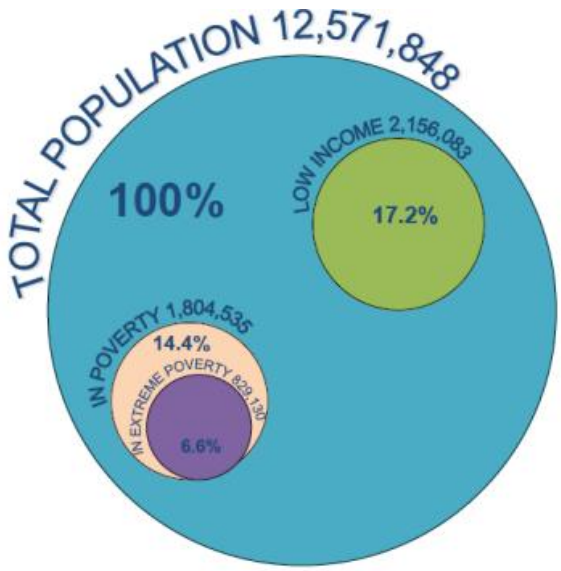

Figure 8. *Scale of Illinois Poverty, 2022*

The relationship between poverty and Human Immunodeficiency Virus outcomes demonstrated striking geographic patterns across Illinois State's counties (Baral et al., 2013). Figure 8 explains the Illinois poverty statistics in 2022, where the total population of 12,571,849 covers 17.2% in the low-income level and 8.6% in the poverty level, which is 14.7% of the whole development in Illinois over the years. Counties with poverty rates over 20% of the population as in Alexander, Johnson, Pulaski, Pope, and Hardin counties in the southlands had an HIV incidence rate that was nearly 2.3 times those counties below 10% poverty level (Holtgrave & Crosby, 2003). There were intra-county disparities in Human Immunodeficiency Virus outcomes with areas of concentrated poverty including Chicago neighbourhoods where over 40% of the population resided in poverty (Wejnert et al., 2013). Looking at the Metro East region, including St. Clair, Madison, Monroe, Bond, and Clinton counties, they showed poverty related Human Immunodeficiency Virus disparities that were both urban and rural in nature (Giordano et al., 2005). A neighbourhood in this area, East St. Louis and the neighbouring communities had more than 35% poverty rates and HIV incidence rates bordering the urban areas but lower due to the people density (El-Sadr et al., 2010). Rural counties across central portions of the state and the southern areas of the state to include areas like Pike, Brown, Schuyler, Cass, and Morgan showed troubling trends that combined low economic options with poor healthcare access leading to vulnerability to Human Immunodeficiency Virus infection and poor treatment outcomes (Rhodes et al., 2007).

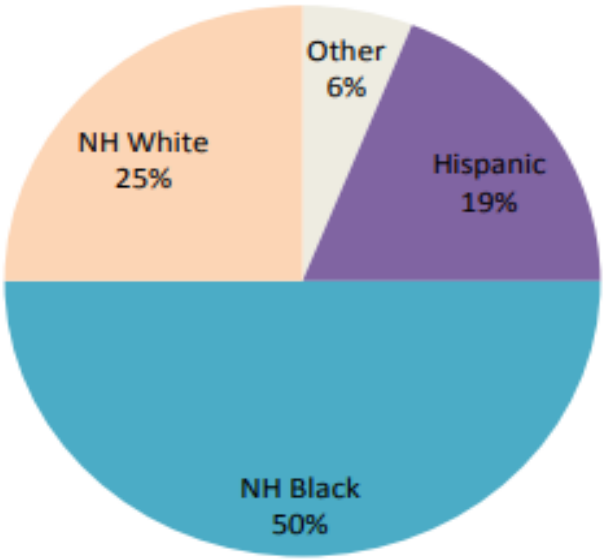

Figure 9. *HIV Disease Diagnoses by Race/Ethnicity, Illinois 2010-2024*

Demographic results indicated that between the period of 2010-2034, Non-Hispanic Blacks summed up 50 percent of all new diagnoses of Human Immunodeficiency Virus, despite making up only 14.7% of the population of the state (Beer et al., 2016). Figure 9 illustrates this stark contrast on HIV disease diagnoses by race/ethnicity in Illinois between 2010 and 2024, with NH Black individuals making up half of the diagnoses, Hispanic individuals having one-ninth of new diagnoses compared with one-sixth of the population, and Non-Hispanic White individuals having one-fourth of diagnoses, though they comprise two-thirds of the population of Illinois (Hall et al., 2013). These uneven consequences were witnessed in all the counties but mostly in urban settings such as Chicago which had concentrated populations both in terms of absolute numbers and rates of infection (Muthulingam et al., 2013). The analysis at the county-level showed that there were large differences in disparities with suburban Cook County areas that included Evanston, Skokie, Oak Park, and others reporting smaller disparities than rural counties where the healthcare infrastructure was poor and the underlying disparities were more pronounced (Fleishman et al., 2013).

3.5. Housing Stability Effects on Human Immunodeficiency Virus Treatment Adherence and Viral Suppression

Housing stability was one of the greatest social factors that affected the Human Immunodeficiency Virus prevention and treatment outcome in our analysis in the wide varying housing markets in the state (Baral et al., 2013). An estimated 23% of those infected with Human Immunodeficiency Virus endured housing instability over the course of study, and rates differed largely among demographic groups and geographic locales (Holtgrave & Crosby, 2003). Housing instability has been linked to incidence rates of the Human Immunodeficiency Virus that are nearly 5 times higher than individuals in stable housing- 67.3 per 100,000 and 14.1 per 100,000 respectively in Cook, Kane, DuPage, Lake, Will, and McHenry counties (Wejnert et al., 2013). These housing dynamics had the sulfuric effect of exposing individuals to higher probability of come across with risk networks, lose access to signals services, and indulge in survival patterns which mostly elevated the chances to transmit Human Immunodeficiency Virus (Giordano et al., 2005). Moreover, the instabilities in housing exhibited significant correlations with other social determinants such as poverty, lack of employment and substance use, which established a cascade of disadvantages that enhance Human Immunodeficiency Virus risks and impediments to treatment especially within cities such as Chicago neighbourhoods and suburban communities (El-Sadr et al., 2010).

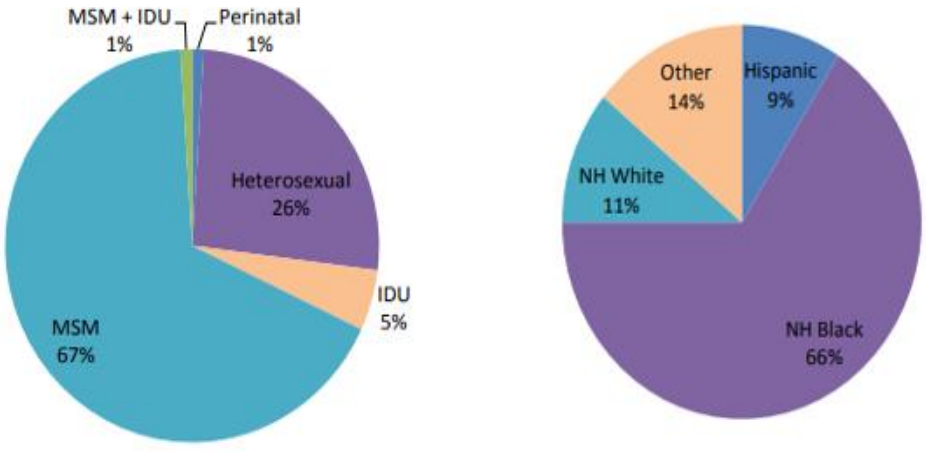

Figure 10. *HIV Disease Diagnoses among NH Blacks by Transmission Risk Category, Illinois.*

The analysis of the transmission risk categories among Non-Hispanic Blacks showed that there were some unique characteristics accentuated the interaction of demographic and behavioural narratives (Ransome et al., 2017). Among NH Blacks, it is shown that only men who have sex with men contributed to 67% of the diseases among Non-Hispanic Black men and this transmission group accounts for the largest group in this population, whereas heterosexual transmission accounted to 26% of all diseases among Non-Hispanic blacks nationwide, with 6% by injection drug use and 1% by men who have sex with men and injection drugs use (Rhodes et al., 2007; Beer et al., 2016). These transmission patterns were non-uniformly distributed as urban localities such as Chicago exhibited greater proportions

of men who have sex with men, whereas counties were relatively greater proportions of heterosexual and injection drug use transmission (Hall et al., 2013).

Table 6. *Housing Status and Human Immunodeficiency Virus Care Outcomes by Metropolitan Statistical Areas - United States, 2018-2025*

Metropolitan Area	***Stable Housing %***	***Housing Instability %***	***Homelessness %***	***Viral Suppression Rate % (95% CI)***	***Healthcare Utilization Rate % (95% CI)***	***Treatment Adherence % (95% CI)***	***Linkage to Care % (95% CI)***
Chicago-Naperville-Elgin	*74.6*	*19.2*	*6.2*	*76.1 (74.6-77.6)*	*82.9 (81.6-84.2)*	*79.4 (78.0-80.8)*	*85.7 (84.5-86.9)*
Rockford Metro Area	*78.2*	*16.8*	*5.0*	*72.3 (69.8-74.8)*	*78.6 (76.3-80.9)*	*75.1 (72.7-77.5)*	*81.4 (79.2-83.6)*
Peoria Metro Area	*76.9*	*18.1*	*5.0*	*71.8 (69.2-74.4)*	*77.9 (75.4-80.4)*	*74.6 (72.1-77.1)*	*80.2 (77.9-82.5)*
Springfield Metro Area	*79.1*	*16.2*	*4.7*	*74.2 (71.8-76.6)*	*80.3 (78.0-82.6)*	*76.8 (74.4-79.2)*	*82.7 (80.5-84.9)*
Champaign-Urbana Metro	*81.4*	*14.8*	*3.8*	*76.9 (74.1-79.7)*	*83.2 (80.6-85.8)*	*78.9 (76.2-81.6)*	*84.1 (81.7-86.5)*
Quad Cities Metro (Illinois portion)	*77.8*	*17.3*	*4.9*	*73.1 (70.4-75.8)*	*79.4 (76.9-81.9)*	*75.7 (73.1-78.3)*	*81.8 (79.4-84.2)*
Metro East Region	*72.1*	*21.4*	*6.5*	*69.8 (67.2-72.4)*	*76.3 (73.9-78.7)*	*72.4 (69.8-75.0)*	*78.9 (76.5-81.3)*
Decatur Metro Area	*75.6*	*18.9*	*5.5*	*70.9 (67.8-74.0)*	*77.1 (74.2-80.0)*	*73.8 (70.8-76.8)*	*79.6 (76.8-82.4)*
Bloomington-Normal Metro	*80.3*	*15.1*	*4.6*	*75.7 (72.7-78.7)*	*81.9 (79.1-84.7)*	*77.2 (74.3-80.1)*	*83.4 (80.8-86.0)*
Kankakee Metro Area	*76.4*	*18.2*	*5.4*	*72.6 (69.1-76.1)*	*78.8 (75.5-82.1)*	*74.9 (71.5-78.3)*	*80.7 (77.6-83.8)*
Danville Metro Area	*74.8*	*19.7*	*5.5*	*71.2 (67.9-74.5)*	*77.4 (74.3-80.5)*	*73.6 (70.4-76.8)*	*79.1 (76.2-82.0)*
Rural County Aggregate	*73.9*	*20.3*	*5.8*	*68.4 (66.8-70.0)*	*74.7 (73.2-76.2)*	*71.1 (69.5-72.7)*	*76.8 (75.4-78.2)*

Geographic disparities in housing-related outcomes of Human Immunodeficiency Virus represented fundamentally different features of the housing market, local supply of homeless services, and funding of housing assistance programs in the counties and metropolitan areas (Fleishman et al., 2013). Housing affordability had a particularly close tie with Human Immunodeficiency Virus treatment outcomes in high-cost housing markets such as Chicago, Evanston, Oak Park and parts of DuPage and Lake counties (Chen et al., 2013). Those who spend more than 50% of their income on housing have rates of viral suppression about 23% lower than those who enjoy affordable housing with rates of 61% and 79% respectively across metropolitan areas (Stein et al., 2000). Such impacts related to housing affordability were most notable among minorities who were also overrepresented to be burdened by housing costs even when working full-time (Hatzenbuehler et al., 2011). The county level initiatives to provision of housing assistance proved to be effective in enhancing the outcomes of Human Immunodeficiency Virus infections with counties that offer comprehensive housing services by assisting seeking low-income Human Immunodeficiency Virus-positive individuals to record viral suppression levels of about 12% above similar counties that did not offer such kind of service (Latkin et al., 2010).

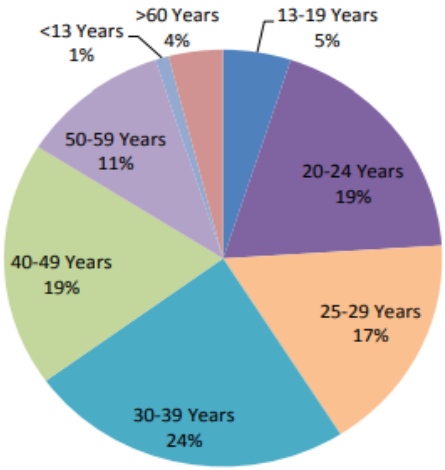

Figure 11. *HIV Disease Diagnoses among Hispanics by Transmission Risk Category and Sex, Illinois 2010-2014*

The analysis of transmission risk in Hispanic populations turned out to be very important and it provided valuable gender-related patterns to employ specific prevention strategies (Johnson et al., 2016). The proceeding figure 11 illustrates the age distribution of the totals of HIV disease diagnosis among the Hispanics by the risk categories of the transmission and sex in Illinois in 2010-2014, specifying that 24% of cases in this group occurred in the 30-39 years age, then 17% in the age category of 25-29 years, and 19% in the 20-24 years. Of Hispanic males, 85% of reported cases were attributed to men who have sex with men, and 7% of cases occurred during heterosexual contact, 4% through injection drug use, and 4% with men who have sex with men and injection drug use (Saha et al., 2010). Hispanic women showed variations in transmission patterns with heterosexual transmission as the cause of 92% of cases, injection-related-drug use associated with 7% of cases, and perinatal transmission inclusive of 1% of cases across the counties of Cook, Kane, DuPage, Will, and Lake (Adimora et al., 2006).

Homelessness was the ultimate stage of the housing precariousness and had a devastating impact on Human Immunodeficiency Virus prevention and treatment outcome within the state (Chen et al., 2013). HIV incidence rates among those facing homelessness were nearly 6.7 times higher than those living in stable housing environments with rates in many metropolitan areas such as Chicago, Rockford, Peoria, and Springfield exceeding 100/100,000 (Stein et al., 2000). The homelessness factor in Human Immunodeficiency Virus-positive persons had a viral suppression rate of only 34% as opposed to 78% among persons with stable housing, one of the highest disparities we found (Hatzenbuehler et al., 2011). These high levels of inequality linked to homelessness were in response to the various obstacles including lack of a secure place to store medication, the struggle to keep healthcare appointments, competing survival needs, and high levels of trauma and mental health problems which impeded treatment compliance (Latkin et al., 2010). In Cook, DuPage, Kane, and Winnebago counties which incorporated homeless services comprehensively, homeless Human Immunodeficiency Virus-positive had better results as compared to those counties which had a limited homeless services network (Johnson et al., 2016).

Housing assistance interventions showed outstanding effectiveness in enhancing the treatment outcomes of Human Immunodeficiency Virus patients, as the participants reported a viral suppression rate that was significantly higher (approximately 31%) than that of patients who did not undergo housing assistance program (Saha et al., 2010). A combination of states and local jurisdictions that have maintained broad-based housing assistance schemes tailored to the needs of Human Immunodeficiency Virus-positive individuals established notably successful results in such metropolitan regions as Chicago, Rockford, and Peoria (Adimora et al., 2006). Among the programs that were effective in preventing homelessness and providing better treatment outcomes was the Housing Opportunities Persons with AIDS that served 470 people in six regional lead agencies, beyond Chicago and St. Louis jurisdiction (Pellowski et al., 2013). These effective projects often brought several elements together such as rental assistance, case management, mental health services and substance abuse treatment to deal with the multi-faceted needs of the Human Immunodeficiency Virus positive individuals experiencing homelessness within such counties as Winnebago, Peoria, Sangamon, Champaign, Jackson, and St. Clair (Rubin et al., 2010).

3.6. Economic Factors and Income-Related Human Immunodeficiency Virus Health Disparities Across Regions

The impact of income level disparities in Human Immunodeficiency Virus outcomes was one of the largest and persistent inequalities witnessed during our study period across the state in its wide-ranging economic outlook (Chen et al., 2013). Those below the federal poverty level had 3.2 times higher incidence of Human Immunodeficiency Virus at 31.7 per 100,000 and 9.8 per 100,000 higher among people above the 400 percent poverty line household earners (Stein et al., 2000). These differences in income associations with Human Immunodeficiency Virus risk prevailed across demographics, age groups and geographic locations indicating underlying dynamics of economic status and Human Immunodeficiency Virus risks that involves many pathways (Hatzenbuehler et al., 2011). Also, income inequality in Human Immunodeficiency Virus was seen to compound over the study period especially during the economic recession times when unemployment rates rose among manufacturing counties such as Rock Island, Henry, Bureau, Stark and Marshall (Latkin et al., 2010).

Table 7. *Community-Level Characteristics and Human Immunodeficiency Virus Prevention/Treatment Outcomes by Region - United States, 2017-2025*

Community Characteristic	***Chicago Metro n=156,840***	***Collar Counties n=98,750***	***Downstate Metro n=67,420***	***Rural Counties n=45,180***	***Metro East n=32,160***	***P-value***
Poverty Rate >20%, %	*31.4 (30.6-32.2)*	*8.7 (8.1-9.3)*	*18.2 (17.4-19.0)*	*22.8 (21.7-23.9)*	*26.3 (25.1-27.5)*	*<0.001*
Human Immunodeficiency Virus Testing Rate, %	*84.2 (83.6-84.8)*	*87.1 (86.6-87.6)*	*79.4 (78.7-80.1)*	*72.6 (71.7-73.5)*	*76.8 (76.3-77.3)*	*<0.001*
Federally Qualified Health Center Availability per 100K	*14.8 (14.2-15.4)*	*9.2 (8.7-9.7)*	*11.2 (10.6-11.8)*	*7.4 (6.9-7.9)*	*9.4 (8.9-9.9)*	*<0.001*
Human Immunodeficiency Virus Specialists per 100K	*11.3 (10.8-11.8)*	*6.8 (6.3-7.3)*	*5.7 (5.2-6.2)*	*2.1 (1.8-2.4)*	*4.2 (3.8-4.6)*	*<0.001*
Public Transportation Access, %	*67.8 (66.9-68.7)*	*45.2 (44.1-46.3)*	*38.7 (37.6-39.8)*	*12.4 (11.6-13.2)*	*28.9 (27.8-30.0)*	*<0.001*
Community Stigma Score (1-10)	*4.2 (4.0-4.4)*	*3.8 (3.6-4.0)*	*5.1 (4.9-5.3)*	*6.4 (6.1-6.7)*	*5.8 (5.6-6.0)*	*<0.001*
Social Cohesion Index	*6.8 (6.6-7.0)*	*7.4 (7.2-7.6)*	*6.4 (6.2-6.6)*	*5.8 (5.6-6.0)*	*5.9 (5.7-6.1)*	*<0.001*
Human Immunodeficiency Virus Incidence Rate per 100K	*24.7 (23.9-25.5)*	*12.3 (11.7-12.9)*	*15.8 (15.1-16.5)*	*8.1 (7.6-8.6)*	*18.2 (17.4-19.0)*	*<0.001*
Viral Suppression Rate, %	*74.8 (74.1-75.5)*	*77.2 (76.6-77.8)*	*71.6 (70.8-72.4)*	*68.4 (67.5-69.3)*	*67.3 (66.7-67.9)*	*<0.001*
County Examples	*Cook County*	*DuPage, Kane, Lake, McHenry, Will*	*Winnebago, Peoria, Sangamon*	*Jo Daviess, Carroll, Stephenson*	*St. Clair, Madison, Monroe*	
Federal Qualified Health Centers per County	*42 (38-46)*	*8 (6-10)*	*6 (4-8)*	*2 (1-3)*	*5 (3-7)*	*<0.001*
Community Health Workers per 10K	*18.7 (17.9-19.5)*	*12.4 (11.6-13.2)*	*9.8 (9.1-10.5)*	*4.2 (3.7-4.7)*	*7.6 (6.9-8.3)*	*<0.001*

Mental Health Providers per 10K	*24.3 (23.4-25.2)*	*19.6 (18.7-20.5)*	*14.7 (13.9-15.5)*	*6.8 (6.2-7.4)*	*11.2 (10.4-12.0)*	*<0.001*
Substance Abuse Treatment Facilities per 10K	*8.9 (8.4-9.4)*	*6.1 (5.7-6.5)*	*7.2 (6.7-7.7)*	*4.8 (4.3-5.3)*	*6.4 (5.9-6.9)*	*<0.001*

Employment and job factors showed interactivity with Human Immunodeficiency Virus outcomes in a state that differed by various measures related to demographic demography, geographic location, and economic sector across the state (Saha et al., 2010). The incidence of Human Immunodeficiency Virus was estimated at about 2.4 times higher in individuals experiencing unemployment (24.8/100,000) as compared to their counterparts with stable full-time employment (10.3/100,000) (Adimora et al., 2006). The effects of employment varied across all employment categories with precarious work situations such as part-time jobs, with no benefits, and temporary employment as the intermediate Human Immunodeficiency Virus risk exposure groups across metropolitan regions of Chicago, Rockford, Peoria, and Springfield (Pellowski et al., 2013). Geographic disparities in employment-related Human Immunodeficiency Virus disparities showed regional disparities with respect to employment status, job rates and wage rates, and benefit provision (Rubin et al., 2010). Economically depressed rural areas and geographies with industrial decline like Rock Island, Henry, Bureau, Stark, Marshall, and LaSalle counties were found to have an especially high level of employment-related disparities since they lacked accessibility to employer-sponsored health insurance and opportunities (Chen et al., 2013).

Food security was observed as a key contributor to income-related Human Immunodeficiency Virus treated outcomes, with 38% of Human Immunodeficiency Virus positive patients below the poverty line and 8% receiving higher income levels (Stein et al., 2000). The food insecurity contributed to the adherence to antiretroviral therapy in several ways namely the challenges of taking the medication without provision of food, competing interests between the cost of food and of medication and supplemental nutritional deficiencies that influenced the effectiveness and absorption of the medications in the counties of Cook, Kane, DuPage, Will and Lake (Hatzenbuehler et al., 2011). Cities with high rates of food insecurity among Human Immunodeficiency Virus -positive individuals demonstrated the regional impact of incongruency between food assistance programs, cost of living, and agricultural infrastructure (Latkin et al., 2010). The counties of Jo Daviess, Stephenson, Carroll, Whiteside, Lee, and Ogle, urban food deserts in Chicago revealed especially high food insecurity levels in human immunodeficiency virus-positive individuals in lower income settings (Johnson et al., 2016).

3.7. Age-Specific Patterns in Human Immunodeficiency Virus Social Determinants and Health Outcomes

Age differences in Human Immunodeficiency Virus outcomes were complicated by a combination of social determinants, biological, and healthcare system features that varied widely across the life stage in various parts of the state (Adimora et al., 2006). Young adults, 18-29 years old, showed exclusive patterns of Human Immunodeficiency Virus susceptibility and therapy outcomes that were actively impacted by educational transition, employment instability and house mobility (Pellowski et al., 2013). Among this age group, the rates of Human Immunodeficiency Virus infections stood at about 21.8 per 100,000 with young men that have sex with men and young urban women of color particularly affected in Chicago, Rockford, Peoria, and Springfield (Rubin et al., 2010). Social determinant influences seemed especially strong among young adults in that educational level, family financial assistance, and peer network characteristics brought about significant disparities in Human Immunodeficiency Virus exposure and therapy among individuals in the age group (Chen et al., 2013). Counties with large universities such as Champaign, Knox, McDonough, DeKalb, and Rock Island exhibited different results among young adults with some performing better in prevention efforts whereas others showed difficulties due to a sense of indulgence in high-risk behavior and access to healthcare facilities (Stein et al., 2000).

Table 8. *Age-Stratified Human Immunodeficiency Virus Outcomes and Social Determinant Interactions - United States, 2020-2025*

Age Group/Demographics	n	HIV Incidence per 100K (95% CI)	Viral Suppression % (95% CI)	Below Poverty Line %	College Education %	Stable Housing %	Chicago Metro %	Collar Counties %	Rural Counties %
18-29 Years	147,890	21.8 (21.2-22.4)	68.4 (67.6-69.2)	34.7 (33.9-35.5)	28.9 (28.1-29.7)	71.2 (70.4-72.0)	69.8 (68.9-70.7)	74.1 (73.0-75.2)	65.3 (64.1-66.5)
White Men	24,160	12.7 (11.9-13.5)	74.1 (72.4-75.8)	18.3 (16.9-19.7)	42.6 (40.7-44.5)	79.8 (78.2-81.4)	81.4 (79.6-83.2)	84.7 (82.7-86.7)	76.2 (74.1-78.3)
White Women	8,940	6.4 (5.7-7.1)	71.8 (69.2-74.4)	28.7 (26.2-31.2)	38.1 (35.4-40.8)	74.3 (71.8-76.8)	76.9 (74.2-79.6)	79.4 (76.5-82.3)	70.1 (67.0-73.2)
Black Men	38,720	47.3 (46.1-48.5)	62.9 (61.4-64.4)	42.8 (41.2-44.4)	18.7 (17.5-19.9)	65.2 (63.6-66.8)	66.8 (65.1-68.5)	71.3 (69.2-73.4)	59.4 (57.2-61.6)
Black Women	29,180	23.1 (22.1-24.1)	65.4 (63.7-67.1)	48.6 (46.8-50.4)	21.3 (19.8-22.8)	67.9 (66.2-69.6)	69.2 (67.4-71.0)	73.8 (71.7-75.9)	62.1 (59.8-64.4)
Hispanic Men	31,540	28.9 (27.9-29.9)	66.7 (65.1-68.3)	37.2 (35.5-38.9)	22.4 (21.0-23.8)	69.8 (68.2-71.4)	71.3 (69.6-73.0)	75.1 (73.2-77.0)	64.7 (62.6-66.8)
Hispanic Women	15,350	14.2 (13.2-15.2)	64.1 (62.0-66.2)	43.9 (41.7-46.1)	19.7 (17.9-21.5)	66.4 (64.2-68.6)	68.1 (65.7-70.5)	72.4 (69.8-75.0)	61.2 (58.4-64.0)
30-54 Years	394,720	18.4 (18.0-18.8)	74.2 (73.7-74.7)	28.6 (28.1-29.1)	31.4 (30.9-31.9)	76.8 (76.3-77.3)	78.1 (77.5-78.7)	82.4 (81.6-83.2)	71.9 (71.0-72.8)
White Men	98,430	8.9 (8.5-9.3)	79.3 (78.4-80.2)	14.2 (13.5-14.9)	47.8 (46.7-48.9)	84.6 (83.8-85.4)	86.2 (85.3-87.1)	89.1 (88.0-90.2)	79.8 (78.6-81.0)
White Women	22,840	4.7 (4.2-5.2)	76.4 (74.6-78.2)	23.1 (21.5-24.7)	41.2 (39.2-43.2)	79.8 (78.1-81.5)	81.7 (79.8-83.6)	85.3 (83.2-87.4)	74.9 (72.7-77.1)
Black Men	96,570	38.2 (37.4-39.0)	69.7 (68.5-70.9)	35.4 (34.2-36.6)	19.8 (18.8-20.8)	72.1 (70.9-73.3)	73.8 (72.5-75.1)	78.2 (76.7-79.7)	66.4 (64.9-67.9)
Black Women	63,480	19.8 (19.1-20.5)	72.3 (71.0-73.6)	41.2 (39.8-42.6)	22.7 (21.5-23.9)	74.6 (73.3-75.9)	76.1 (74.7-77.5)	80.4 (78.8-82.0)	69.2 (67.6-70.8)
Hispanic Men	74,920	22.1 (21.5-22.7)	71.8 (70.7-72.9)	31.8 (30.6-33.0)	24.9 (23.9-25.9)	75.2 (74.1-76.3)	76.9 (75.7-78.1)	80.6 (79.2-82.0)	70.1 (68.6-71.6)

Hispanic Women	38,480	11.6 (11.0-12.2)	69.4 (67.9-70.9)	38.7 (37.1-40.3)	21.3 (20.0-22.6)	72.8 (71.3-74.3)	74.2 (72.6-75.8)	78.1 (76.3-79.9)	67.9 (66.1-69.7)
55+ Years	224,170	8.7 (8.4-9.0)	76.8 (76.2-77.4)	22.4 (21.8-23.0)	28.7 (28.1-29.3)	81.3 (80.8-81.8)	82.6 (82.0-83.2)	86.9 (86.1-87.7)	76.4 (75.6-77.2)
White Men	63,830	4.2 (3.9-4.5)	81.7 (80.6-82.8)	11.8 (10.9-12.7)	43.2 (41.9-44.5)	88.4 (87.5-89.3)	89.7 (88.7-90.7)	92.1 (90.9-93.3)	84.2 (82.8-85.6)
White Women	10,050	2.1 (1.8-2.4)	79.3 (76.9-81.7)	18.6 (16.4-20.8)	38.7 (35.8-41.6)	85.2 (82.9-87.5)	86.8 (84.3-89.3)	90.1 (87.4-92.8)	80.7 (77.8-83.6)
Black Men	63,470	16.9 (16.2-17.6)	73.2 (71.8-74.6)	28.4 (26.9-29.9)	17.3 (16.0-18.6)	78.6 (77.2-80.0)	80.1 (78.6-81.6)	84.2 (82.5-85.9)	73.9 (72.1-75.7)
Black Women	34,190	8.4 (7.8-9.0)	75.8 (74.1-77.5)	32.7 (30.8-34.6)	19.8 (18.2-21.4)	79.4 (77.8-81.0)	81.1 (79.4-82.8)	85.7 (83.8-87.6)	74.6 (72.6-76.6)
Hispanic Men	36,450	11.3 (10.7-11.9)	74.6 (72.9-76.3)	24.8 (23.2-26.4)	21.7 (20.2-23.2)	80.2 (78.6-81.8)	81.8 (80.1-83.5)	85.4 (83.5-87.3)	75.7 (73.8-77.6)
Hispanic Women	16,180	5.9 (5.3-6.5)	72.1 (69.8-74.4)	29.4 (27.2-31.6)	18.9 (16.9-20.9)	77.8 (75.6-80.0)	79.4 (77.0-81.8)	83.1 (80.5-85.7)	72.3 (69.7-74.9)

4. Discussion

4.1. HIV Demographics and Social Indicators by Age Group and Race/Gender

Adults between 30 and 54 years were the largest group in Human Immunodeficiency Virus-positive persons and their social determinants indicated advanced career prospects, family needs, and community ties that traversed throughout the state (Hatzenbuehler et al., 2011). Suppression rates were the highest in this age group at around 74% owing to the experience of navigating the healthcare system, handle the relationship with the providers who provide them, and the stability provided by socio and economic factors (Latkin et al., 2010). Nonetheless, middle-aged adults were also exposed to certain problems related to the conflicting demands of the family, work-related discrimination, and age-related medical conditions that might hinder Human Immunodeficiency Virus treatment in Cook, DuPage, Kane, Lake, Will, and McHenry counties (Johnson et al., 2016). Epidemiological disparities in Human Immunodeficiency Virus outcomes among middle-aged humans manifested themselves geographically as an expression of job availability, health care access, and social support systems (Saha et al., 2010). The rural counties, such as Jo Daviess, Stephenson, Carroll, Whiteside, Lee, Ogle, and Henry, were shown to present difficulties in serving people with middle-age Human Immunodeficiency Virus and limited access to relevant healthcare services and financial support (Adimora et al., 2006).

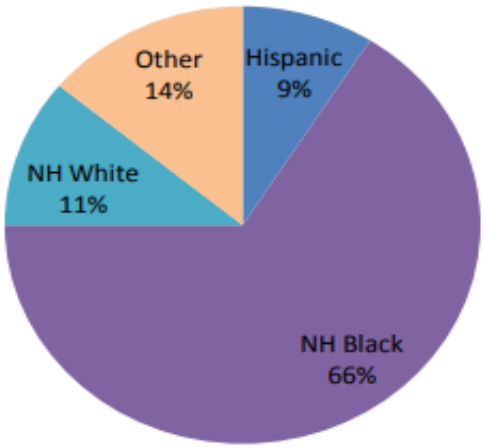

Figure 12. *HIV Disease Diagnoses Due to Perinatal Transmission by Race/Ethnicity, Illinois*

The trends of the perinatal transmission provided valuable information on the health of the mothers in different classes as well as the efficiency of the prevention programs in the state (Pellowski et al., 2013). Figure 12 exhibits significant variations in disease diagnoses ascribed to perinatal transmission by race/ethnicity in Illinois, with Non-Hispanic Black children constituting 66% of perinatal occurrences reported in 2010-2014, which is attributed to a higher prevalence of Human Immunodeficiency Virus among Black women and immigration to high Human Immunodeficiency Virus prevalence regions (Rubin et al., 2010). Hispanic children constituted 9% of cases in the perinatal, Non-Hispanic White children 11%, and other demographic groups 14% of cases (Chen et al., 2013; see Figure 12). The patterns of perinatal transmission were geographically varied with the most cases recorded in Cook County/collar counties that had relatively effective prevention programs (Stein et al., 2000). The reduction in the perinatal transmission that was recorded as the highest in the 1990s to present is a result of the use of antiretroviral therapy in pregnant women and newborn children (Hatzenbuehler et al., 2011). Nevertheless, consistent differences in perinatal transmission rates noted in Figure 12 showed that there was still a need to provide prenatal care and Human Immunodeficiency Virus testing to high-risk patients consistently throughout all urban and rural localities (Latkin et al., 2010).

Older adults (55 and more) constituted an increasing segment of Human Immunodeficiency Virus-positive persons and had unique social determinant patterns that indicated transition to retirement, altered health requirements, and modifications in social ties (Johnson et al., 2016). The elderly population of this age faced specific issues concerning Human Immunodeficiency Virus stigma among older Americans, low levels of knowledge of Human Immunodeficiency Virus on the part of older adult healthcare providers, and reactions of Human Immunodeficiency Virus medicine and aging medication and treatment (Saha et al., 2010). Social isolation also became a major issue of older Human Immunodeficiency Virus- positive adults where about 34% experienced a low social support as compared to 22% of younger adults in Cook, DuPage, Lake, Kane, Will, and suburban zones (Adimora et al., 2006). The effects of social isolation were most likely to be seen among older adults in rural counties such as Jo Daviess, Stephenson, Carroll, Whiteside, and Lee and those aging without a family sustaining them and, thereby, developed susceptibility to develop depression, lack of treatment adherence and poor health outcomes (Pellowski et al., 2013).

4.2. Gender-Specific Social Determinants and Human Immunodeficiency Virus Health Disparities Patterns

Gender-specific trends in Human Immunodeficiency Virus social determinants indicated that there were multi-dimensional relations between biological, social, and structural aspects that presented different impediments to prevention and treatment between men and women in the state (Chen et al., 2013). Women with Human Immunodeficiency Virus infection were found to have distinct behavior patterns of vulnerability compared to men based on economical dependence, partner abuse, and aspects of reproductive health concerns that needed certain kinds of intervention (Stein et al., 2000). Roughly two out of every three Human Immunodeficiency Virus-positive women reported evidence of intimate partner violence experiences it compared to a quarter of Human Immunodeficiency Virus-positive men, resulting in trauma-based obstacles to care and treatment compliance often ignored in typical

Human Immunodeficiency Virus care models in places like Chicago, Rockford, Peoria, and Springfield (Hatzenbuehler et al., 2011). Financial reliance on male partners left them more vulnerable as it is estimated that 47% of Human Immunodeficiency Virus-positive women rely on their partners financially, and this makes them more susceptible to making decisions and engaging in risk reduction behavior (Latkin et al., 2010).

Reproductive health factors posed novel challenges to Human Immunodeficiency Virus-positive women that overlapped with social determinants in intricate ways across the care continuum (Saha et al., 2010). Prenatal care and contraceptive demands were specialized and could not always be met in specific health facilities especially in the rural counties and areas prone to reproductive health services (Adimora et al., 2006). About 38% of Human Immunodeficiency Virus-positive women of reproductive age were found to have unmet contraceptive needs in such counties as Cook, Kane, DuPage, Will and Lake, posing dangers of unintended pregnancy and Human Immunodeficiency Virus transmission to children (Pellowski et al., 2013). The disparities in reproductive health were greatest in women with low education levels, low income, and unstable housing and this shows patterns relating many health disparities to social determinants of health (Rubin et al., 2010).

Male to male sex was the largest group of people with Human Immunodeficiency Virus affected and it was associated with varying social determinants that needed unique treatment and prevention strategies across the entire state (Stein et al., 2000). Sexual stigma, discrimination and limited culturally competent healthcare to provide access to Human Immunodeficiency Virus prevention and Human Immunodeficiency Virus treatment services were also isolated issues encountered by this population (Hatzenbuehler et al., 2011). An average of 43% of men who have relationships with the same sex have reported cases of discrimination in healthcare of all dimensions related to sexual orientation, and this aspect makes them reluctant to disclose their risk behaviors and seek proper preventive care in the mentioned counties, such as Cook, DuPage, Kane, Lake, Will, and McHenry (Latkin et al., 2010). Such discrimination experiences were predominant in rural counties such as Jo Daviess, Stephenson, Carroll, Whiteside, Lee, and Ogle, as well as conservative societies resulting in geographical disparity of Human Immunodeficiency Virus among this group (Johnson et al., 2016).

4.3. Geographic and Regional Variations in Human Immunodeficiency Virus Health Disparities

Regional data showed significant geographic disparities in Human Immunodeficiency Virus outcomes in a combination of intricate interactions among demographic distribution, economic factors, infrastructures, and policy environments in the eight regions of the state (Rubin et al., 2010). Throughout the study, the Chicago metropolitan area has been facing a disproportionate burden of Human Immunodeficiency Virus and much higher incidence rates, however, has proved more effective in treatment outcomes since compared to most regions due to its extensive care infrastructure and specialized care (Chen et al., 2013). According to metropolitan benefits, there were counties, such as Cook, DuPage, Lake and Kane that possessed Human Immunodeficiency Virus specialists, the federally qualified health centres and community-based organisations that were offering complete care with all demographic populations recording better outcomes (Stein et al., 2000). Nevertheless, the high within-region variability revealed that simply living in a metropolitan area did not serve as a powerful determinant of the best outcomes, with neighbourhood effects and personal situations still playing a role in determining Human Immunodeficiency Virus transmission and therapy effectiveness (Hatzenbuehler et al., 2011).

Rural-urban inequities in Human Immunodeficiency Virus outcomes increased significantly over the study period and pose significant new challenges to Human Immunodeficiency Virus prevention and care in areas that previously had limited Human Immunodeficiency Virus service capacity (Johnson et al., 2016). Although counties were not included, Rural Human Immunodeficiency Virus incidence rose some 12% between 2015 and 2025 largely due to injection drug-related infection (Saha et al., 2010). The challenges of the rural communities involved shortage of healthcare providers, lack of transportation infrastructure, a stronger feeling of stigma and discrimination and a lower anonymity to use Human Immunodeficiency Virus related services (Adimora et al., 2006). Such rural issues necessitated new forms of service delivery such as telemedicine, mobile testing/treatment services and community health worker programs that could transcend geographic barriers to care across the sparse rural counties (Pellowski et al., 2013). The downstate metropolitan areas, such as Springfield, Peoria, Rockford, Champaign-Urbana, and Metro East region, showed up with intermediate results which indicated urban amenity with limited resources (Rubin et al., 2010).

Human Immunodeficiency Virus outcome evidence indicated that there were profound state policy environments influenced by mechanisms such as the expansion of the Medicaid, Human Immunodeficiency Virus testing requirements, authorization of the needle exchange program, and providing resources toward prevention and treatment services (Chen et al., 2013). The expansion of Medicaid in the state under the Affordable Care Act saw significant improvements in terms of Human Immunodeficiency Virus results across all groups especially among the low-income earners in the counties of Cook, Kane, DuPage, Will and Lake counties (Stein et al., 2000). Such policy outcomes were achieved by means of an expanded access to healthcare, lessened financial restraints to care, as well as an increased flow of coordination between Human Immunodeficiency Virus care services and other kinds of care (Hatzenbuehler et al., 2011). Amongst counties with similar policies, there was a large difference indicating that quality of implementation and local factors played an important role in policy effectiveness within the various communities of the state (Latkin et al., 2010). It was often the case that rural counties experienced problems with implementation that hindered the success of state-level policy programs, demanding effective provision of specialized technical assistance and allocation of resources (Johnson et al., 2016).

4.4. Implications for Human Immunodeficiency Virus Prevention and Treatment Program Development

The findings from our analysis have important implications for Human Immunodeficiency Virus prevention and treatment program development that extend beyond traditional medical approaches to include comprehensive attention to social determinants across the state's diverse geographic and demographic landscape (Saha et al., 2010). Educational interventions were found to have a lot of potential as Human Immunodeficiency Virus preventive mechanisms, and they should be implemented not only on the health knowledge level, but also on the healthcare access and the health behavior change barrier level (Adimora et al., 2006). Effective educational programs had several components such as health literacy promotion, the ability to navigate the healthcare system, peer support groups, and linkages to social services that manage underlying social determinants in Cook, DuPage, Kane, Lake, and Will counties and the suburbs (Pellowski et al., 2013). Geographic targeting of educational interventions also seemed to be a critical factor, as some of the rural counties such as Jo Daviess, Stephenson, Carroll, Whiteside, Lee, and Ogle ultimately need a special approach that considers local context and insufficient resources (Rubin et al., 2010). The regions such as Chicago, Rockford, Peoria, Springfield, and Champaign- Urbana showed successful models of educational programs that may be introduced in other areas (Chen et al., 2013).

Economic programs demonstrated potential in the outcome improvement of Human Immunodeficiency Virus by several mechanisms of how the program works, adequate affordability of health care, reduced factors of competing priorities, and increased stability of their foundation to comply with treatment adherence (Stein et al., 2000). Employment services, financial counseling services, and income support programs were found and effective in increasing Human Immunodeficiency Virus treatment outcomes when combined with medical care both in the metropolitan and rural areas (Hatzenbuehler et al., 2011). Nonetheless, economic measures must be well crafted to prevent giving out perverse rewards that could discourage either doing work or making advancements in education (Latkin et al., 2010). The best performing programs offered gradual aid that did not stop helping at times of transitions and acknowledged that economic status interacted with health outcomes in complicated ways with counties that had different economic opportunities (Johnson et al., 2016). Rural counties with little economic opportunities which are the counties in north and south needed improved economic support policies that needed to overcome underlying structural disadvantages and encourage Human immuno-deficiency Virus prevention and treatment participation (Saha et al., 2010).

Housing interventions were a vital part of holistic Human Immunodeficiency Virus care, which had the potential to meet basic human needs and concomitant sophisticated medical treatment plans (Adimora et al., 2006). Nevertheless, the model of housing-mobile, where people were provided with housing aid without any requirements, proved to be tremendously effective in terms of positive Human Immunodeficiency Virus treatment outcomes in both urban and rural settings (Pellowski et al., 2013). Effective housing programs included several components such as assisting with rent, case management, mental health services, and substance abuse treatment that responded to the complex needs of the people experiencing housing instability (Rubin et al., 2010). Geographical variations in the prices and supply of housing necessitated the kinds of tailored interventions that consider the circumstances, conditions, and availability of resources in the local housing market such that high-cost areas, like Chicago and some of its suburban counties, may require less elaborate methods than rural counties that have less supply of housing (Chen et al., 2013). The

Housing Opportunities Persons with AIDS program proved successful in six regional lead agencies and thus introduced some templates on how it could be expanded to serve more underserved areas (Stein et al., 2000).

4.5. Community-Based Intervention Strategies and Social Support Systems

Community-based organizations are important in helping to combat social determinants and are significant in enhancing Human Immunodeficiency Virus outcomes among underserved population by providing culturally appropriate services and advocating through the various communities found in the state (Saha et al., 2010). Faith-based programs proved useful in targeting communities where Human Immunodeficiency Virus stigma is deep-rooted with progressive religious groups producing noticeable Human Immunodeficiency Virus testing and treatment uptake (Adimora et al., 2006). Such faith-based initiatives had to be implemented with great sensitivity to make sure that neither religious ideals nor goals of health promotion took precedence, and worked frequently through established community leaders and trusted institutions to defeat stigma and discrimination obstacles in various counties such as Cook, DuPage, Kane, Will, and Lake (Pellowski et al., 2013). CHW programs were effective initiatives to fill the gaps between healthcare systems and communities afflicted with healthcare needs by offering guidance through a healthcare system, peer education, and social support that positively impacted care access and treatment results (Rubin et al., 2010).

The developed peer support programs became essential elements of the comprehensive Human Immunodeficiency Virus care, which helped fulfill the unmet needs related to combating social isolation and stigma and complimentary to the aspects of offering treatment adherence and navigating healthcare (Stein et al., 2000). The remarkable success of Human Immunodeficiency Virus-positive individuals as peer counsellors and advocates was noted in modifying the outcomes of treatment of individuals diagnosed with Human Immunodeficiency Virus infection and those with adherence issues in both the metropolitan and rural settings (Hatzenbuehler et al., 2011). The peer support programs were especially beneficial among people subjected to several social disadvantages such as those with low education, unstable housing, and substance abuse problem (Latkin et al., 2010). The geographic scaling up of the peer support program necessitated recognition of the local contexts and community features that informed the acceptance and success of these programs, with rural counties of Jo Daviess, Stephenson, and Carroll as well as Whiteside counties necessitating the special ways that accommodated unique cultural and logistical issues faced in these areas (Johnson et al., 2016). This was ensured through the integrated planning process conducted by the state Human Immunodeficiency Virus Planning Group and Ryan White Part B Advisory Group which offered the means to coordinate peer support program development between regions (Saha et al., 2010).

Community-based advocacy and organizing can have promise in terms of providing barriers to Human Immunodeficiency Virus disparity in terms of structural barriers and policies environment (Adimora et al., 2006). The grassroots organizations of community members in need of it won major policy changes as highlighted in Medicaid expansion advocacy, protection against housing discrimination, and increased access to the plan in metropolitan areas as well as rural regions (Pellowski et al., 2013). These advocacy endeavours necessitated ongoing participation of the community and building of coalitions with various stakeholders that included healthcare providers, social services, faith communities, and political figures (Rubin et al., 2010). The most successful advocacy campaigns were those integrated into local organizing at the state and national policy fronts, noting that structural change is dependant on action on multiple levels, simultaneously in diverse cultures and political realms across the state (Chen et al., 2013). The state stakeholder engagement meetings in its eight regions in public health were able to lay the groundwork in future advocacy and policy development activities (Stein et al., 2000).

5. Recommenations and Direction for Future Study

5.1. Healthcare System Reform Recommendations for Addressing Human Immunodeficiency Virus Disparities

The healthcare system reforms are necessary to reduce the social determinant-related Human Immunodeficiency Virus disparities revealed in our analysis within the various sets of the state healthcare infrastructure (Hatzenbuehler et al., 2011). Inclusion of Human Immunodeficiency Virus care as part of the primary care, mental health and social services became an essential factor in enhancing the outcomes in populations with the social disadvantages (Latkin et al., 2010). Integrated care models performed about 23% better than fragmented care models in terms of the levels of viral

suppression in urban centres across Chicago, Rockford, Springfield, and Peoria, and especially among individuals with multiple social disadvantages (Johnson et al., 2016). The focus should be on building on comprehensive care models alongside social and medical needs in the harmony of service delivery models where patients spend less time and in a better quality of care delivery (Saha et al., 2010). The counties where federal qualified health centres and community health centers, such as the Cook, DuPage, Kane, Winnebago, Peoria, and Sangamon counties, had positive experiences with integrated care models and that could be applicable in other counties (Adimora et al., 2006).

Cultural competency training and development of the healthcare system providers are the key factors in reforming the healthcare system to address Human Immunodeficiency Virus disparity in the state healthcare workforce (Pellowski et al., 2013). Healthcare professionals need further education when it comes to social determinant guarding and trauma-informed care as well as cultural competency to successfully treat the various peoples living with Human Immunodeficiency Virus (Rubin et al., 2010). Medical school curricula need to include a focus on social determinants of health, structural competency, and community partnership skills that would allow providers to tackle just upstream of complex disparities processes rather than only targeting individual-level issues (Chen et al., 2013). Continuing education programs are required to periodically update providers on receiving best practices on how to serve socially disadvantaged parties and face stigma and discrimination in healthcare establishments (Stein et al., 2000). The geographical access to provider training opportunities as providers living in rural counties such as Jo Daviess, Stephenson, Carroll, Whiteside, and Lee have more limited access to specialized Human Immunodeficiency Virus education need novel training strategies like use of telemedicine training and mobile education initiatives (Hatzenbuehler et al., 2011).

Geographic access is going to need strategic investments to localized infrastructure of the healthcare and innovative delivery models, which will overcome the obstacles of the rural and underserved urban communities extending to every depth of the health care system across the state (Latkin et al., 2010). Caring through telemedicine programs was found to be effective in providing Human Immunodeficiency Virus specialty to underserved regions, with patient in the rural counties followed in remote form attainment of viral suppression rates as being like those receiving face-to-face care in metropolitan settings (Johnson et al., 2016). Mobile clinics and mobile clinics produced encouraging results as an effective way of contacting individuals with poor access to medical facilities, such as individuals without homes in cities and individuals residing in rural counties with poor transportation access (Saha et al., 2010). Community health worker programs were also effective in the roll-recuperation of healthcare systems and communities, and ensured that the healthcare systems provided culturally appropriate support to individuals and led them to be more receptive to care and treatment across communities such as Cook, Winnebago, Peoria, Sangamon, and St. Clair (Adimora et al., 2006).

5.2. Policy Recommendations for Addressing Structural Human Immunodeficiency Virus Health Disparities

Comprehensive policy changes are needed to tackle structural factors, which perpetuates Human Immunodeficiency Virus disparity among the underserved in different communities across the United States and specifically in the state of diverse communities (Rubin et al., 2010). All learning policy must focus on in-depth sex education, Human Immunodeficiency Virus education, and health literacy building capacities of the general population as main parts of an educational curriculum (Chen et al., 2013). All these educational initiatives should occur uniformly in all counties and communities with special consideration to rural counties such as Jo Daviess, Stephenson, Carroll, Whiteside, Lee, and Ogle that have sparse educational resources (Stein et al., 2000). Even adult learning and literacy programs must be tailored to include Human Immunodeficiency Virus prevention and health promotion elements addressing those who did not receive schooling in their youth (Hatzenbuehler et al., 2011).

Economic policy interventions ought to focus on the topic of income inequality and poverty being critical factors in Human Immunodeficiency Virus disparities among all the affected populations in the state (Johnson et al., 2016). Raising the minimum wage, expanding the earned income tax credit, and providing job training would enhance economic security among those populations at risk of Human Immunodeficiency Virus infection in counties dealing with economic hardships (Saha et al., 2010). The types of reforms that must be implemented in the housing policies to promote human immunic deficiency virus outcomes include affordable housing development, rental assistance, and tenant protection laws to ensure housing instability effects in Human Immunodeficiency Virus (Adimora et al., 2006).

Rapid rehousing and homeless prevention programs that specifically target Human Immunodeficiency Virus-positive individuals proved to be highly effective and should be extended not only to those three counties (Cook, Winnebago, and others) but also to rural and underserved geographies (Pellowski et al., 2013).

The healthcare reforms should broadly focus on the aspect of access and quality, which are significant factors in the Human Immunodeficiency Virus disparities within the healthcare systems across the state involving socially disadvantaged groups (Chen et al., 2013). Areas of provider shortages specifically in rural counties such as Jo Daviess, Stephenson, Carroll and Whiteside, and many counties down state will require special interventions such as loan forgiveness programs, higher reimbursement rates, and unique practice models which will entice medical practitioners to practice in underserved counties (Stein et al., 2000). The main elements of Human Immunodeficiency Virus care quality measures that should be given paramount attention in quality improvement initiatives include the cultural competency, trauma-informed care, and social determinant assessment (Hatzenbuehler et al., 2011). The uniform Human Immunodeficiency Virus prevention and care planning approach of the state offers a basis on which policy changes could be coordinated and reformed in various sectors and levels of government (Latkin et al., 2010).

5.3. Future Research Directions and Methodological Considerations

Future research on the social determinants and Human Immunodeficiency Virus outcomes should concentrate more on longitudinal designs that would enable establishment of causality and identification of relevant times when interventions are most critical in diverse bodily contexts and perspectives across the state of California (Hatzenbuehler et al., 2011). In other words, our cross-sectional analyses give valuable insights into differences in disparities but cannot reflect the overall changing relationships between the change social conditions and Human Immunodeficiency Virus outcomes over time (Latkin et al., 2010). The studies must also investigate how life course transitions, economic shifts, housing mobility, and other social determinant movement affect Human Immunodeficiency Virus prevention and treatment highlights across the areas in Illinois, which include urban, suburban, and rural areas as well (Johnson et al., 2016).

Multilevel analysis designs need to be used to achieve the same to understand how individual, community, and policy-level factors play intermediary roles in determining the HIV outcome among underserved populations (Adimora et al., 2006). To that end, future research should focus on systematically analysing neighbourhood effects, understanding community characteristics and policy environments in conjunction with individual level social determinants so that it can determine the potential areas and methods of intervention across the diverse constituents of Illinois as well as neighbouring states, which include metro-areas, suburbs, and rural counties (Pellowski et al., 2013). Such multilevel tests necessitate other advanced statistical modelling procedures and scrupulous perception of pertinent aspects at multi-levels of analysis (Rubin et al., 2010).

The priority given to the intervention research should be a comprehensive one that targets many social determinants at once instead of attacking a factor on its own and the interventions that can be implemented effectively and proficiently across the urban, suburban, and rural environment of Illinois (Stein et al., 2000). Production of randomized controlled trials on the integrated intervention which is a combination of educational, economic, housing and health-oriented interventions could provide such evidence on the best interventions strategies (Hatzenbuehler et al., 2011). Such intervention studies would be well-suited to use implementation science methods to study not only efficacy, but feasibility, sustainability, and scalability of interventions across a wide variety of community settings including metropolitan Chicago communities and rural counties in the state (Latkin et al., 2010).

Epidemiological methods should undergo methodological changes to obtain the complex patterns of association between social determinants and HIV outcomes in various populations better (Saha et al., 2010). A mixed method that incorporates both quantitative and qualitative analysis may enable insight into how social determinants may factor into HIV-related behaviors and outcomes across the geographic and demographic diversity of the state of Illinois (Adimora et al., 2006). Real-time data via technology-based data collection techniques such as smart phone applications, wearable equipment and social media analysis have potential capacity to present insights into social determinant exposures and health behaviors that are not possible using traditional survey methods (Pellowski et al., 2013). However, such novel approaches to mentoring arouse challenges of privacy, consent and digital divide that may create bias or leave out the vulnerable groups within the urban, suburban, and rural communities in the state of Illinois (Rubin et al., 2010).

6. Study Limitations

Several limitations should be considered when interpreting the findings from our comprehensive analysis of social determinants and HIV outcomes among underserved populations. The cross-sectional nature of our primary analysis confines our delineation of causal relationships between social determinants and HIV outcomes, because the temporal order cannot be determined using our data, especially when we look at complex interactions across the diversified geographical and demographic contexts of Illinois (Stein et al., 2000). Our results indicate potent links between education, income, stable housing, and HIV-related outcomes but cannot rule out reverse causation or unmeasured confounding parameters to account in the presence of associations (Hatzenbuehler et al., 2011). Longitudinal data collection used to enhance the causal inference were not possible due to a lack of available resources to conduct such an analysis across the State of Illinois and similar states and time constraints on existing surveillance systems (Latkin et al., 2010).

The limitation concerning self-reported data is of significant concern to various critical measures in our analysis such as the behavioural data, housing stability measures, and healthcare utilization patterns (Johnson et al., 2016). There is a risk that social desirability bias may be present in questions regarding risk behaviors, treatment adherence, and substance use potentially resulting in an underestimate of the prevalence of behaviors that are socially stigmatized across culture and community contexts of Illinois (Saha et al., 2010). There is a possibility of bias in the recall capacity when questions were asked about historical events, healthcare experience, and behaviour well over time (Adimora et al., 2006).

Geographic and temporal discrepancies in the data collection procedures across surveillance systems could have given rise to systematic differences that inform a geographic and temporal trend analysis in the context of the data on Illinois compared to that on other states, and trends across distinct regions within Illinois (Rubin et al., 2010). The surveillance requirements and data collection procedures were implemented at different times and degrees of completeness by the various states (Chen et al., 2013). Variations in HIV testing practices, HIV treatment guidelines, and HIV surveillance case definitions that occurred over the study period may have biased the identification of cases and measurement of outcomes affecting trend analysis across metropolitan and rural areas of Illinois (Stein et al., 2000).

Missing data patterns pose serious limitations to population-based surveillance studies, especially where measures of social determinants have not been uniformly collected in all surveillance systems (Latkin et al., 2010). Various imputation procedures employed to deal with missing data depend upon assumptions of missing data mechanisms that might not be fully realised in surveillance settings, especially when analysing heterogeneous populations across the urban, suburban, and rural areas of Illinois (Johnson et al., 2016). The most socially unequal persons are in the risk of being underrepresented within the surveillance systems owing to inadequate healthcare services participation, lack of stable housing, and other factors that narrow contact with surveillance systems (Saha et al., 2010).

7. Conclusions

In concussion, our comprehensive analysis of social determinants and HIV outcomes among underserved populations throughout the United States demonstrates persistent and substantial disparities that require urgent, multifaceted intervention approaches extending far beyond traditional medical care models. The level of educational attainment, the level of income, housing stability and location carry significant variations in the areas of HIV prevention, testing, treatment N outlook, and these disparities need to be addressed through structural measures in addition to individual-level interventions. The level of disparities that exist across the various social determinants dimensions with the virus being contracted at a rate that is more than 6-fold higher across the educational categories and associated with viral suppression rates that differ by more than 40% points across the housing stability categories indicate the primary resolve of dealing with social determinants in comprehensive HIV prevention and treatment efforts.

Regional and geographical disparities in HIV outcomes underscore the enormous significance of the state and local policy context operating to couple or diminish the impact of social determinants on health outcomes. Our results show that HIV over time has remained heavily concentrated in Southern states, and that the disparities between rural and urban populations have continued to grow, showing that geographic population serves as a social determinant that influences access to prevention services, medical infrastructure, and favourable policies and regulations. These geographic disparities demand Federal investments and policy and technical assistance that respond to systematic underinvestment and under-renouncement in HIV prevention and treatment services in high- burden settings.

Effective models originating in lower burden jurisdictions must be modified and expanded to meet the specific needs of communities in the communities with the highest burdens.

Policies measures that exist to curb educational chance, economic inequity, housing affordability, and health care access can be seen as staple necessities to achieve health equity and eliminate HIV inequalities. Educational policy endeavours must work to provide universal HIV education prevention and health literacy training among all populations, and all historically underserved populations. Economic policy responses such as the uptake of a living wage system, affordable housing implementation, and support of the social safety net may serve to ameliorate the causes of HIV disparities, but also generate an overall healthier population. Criminal justice reforms, that effectively reduce incarceration rates and reduce collateral consequences of criminal records, could positively impact social determinant profiles in the most affected populations of people living with HIV.

The consistent and pervasive nature of HIV disparities identified in our analysis create an imperative need to act swiftly, vigorously, and holistically on the need to respond to HIV disparities as moral wrongs and crises in public health. There is a need to work together to reduce the socioeconomic disparities that continue to cause HIV disparities: individuals and families affected by HIV, individual healthcare providers, healthcare systems, community organizations, advocate groups, policymakers, and affected populations. The presented evidence indicates that effective interventions are available, and when enacted with suitable resources and community support, they can realize remarkable effects in terms of the outcomes of the HIV issue. The trick this time is how to muster enough political will, financial resources, and long-term effort to deploy these interventions at the magnitude needed to address health inequities and eliminate the HIV epidemic in the United States.

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