

AN INVESTIGATION OF THE RELATIONSHIP BETWEEN HIV AND PRISON
FACILITIES IN TEXAS: THE GEOGRAPHIC VARIATION AND
VULNERABLE NEIGHBORHOOD CHARACTERISTICS

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Thesis Prepared for the Degree of
MASTER OF SCIENCE

UNIVERSITY OF NORTH TEXAS

August 2011

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Kutch, Libbey. *An Investigation of the Relationship between HIV and Prison Facilities in Texas: The Geographic Variation and Vulnerable Neighborhood Characteristics*. Master of Science (Applied Geography), August 2011, 34 pp., 6 figures, 6 tables, references, 30 titles.

Previous research suggests that prisons may be fueling the spread of HIV infection in the general population. In 2005, the HIV rate was more than 2.5 times higher in US prison populations. Environmental factors in prisons such as illicit drug use and unprotected sexual activities can be conducive for HIV transmission. Because the vast majority of prison inmates are incarcerated for less than three years, transmission of HIV between prison inmates and members of the general population may occur at a high rate. The environment in which an individual lives and the entities that comprise it affect the health of that person. Thus the location of prisons within communities, as well as socio-demographic characteristics may influence the geography of HIV infection.

HIV surveillance data, obtained from the Texas Department of State Health Services, were used to investigate the relationship between the location of prison units in Texas and HIV infection rates in the surrounding zip codes. The results suggest that HIV prevalence rates are higher among geographic areas in close proximity to a prison unit. With continued behavioral risks and low treatment adherence rates among individuals infected with HIV, there is a possibility of increased HIV prevalence. Vulnerable places, locations with higher HIV prevalence, should be targeted for resource allocation and HIV prevention and care service. This study illustrates the importance of spatial analysis of places vulnerable to increased HIV prevalence in creating more effective public health prevention strategies and interventions.

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ACKNOWLEDGEMENTS

I would like to extend a special thanks to Dr. Joseph Oppong , Dr. Chetan Tiwari, and Dr. Susie Mikler for their patience, assistance, and guidance throughout the duration of this research. I would also like to thank Aldo Avina, Adam Harold, David Ferring and the rest of the UNT GIS and Public Health Research Group for their support and advice; it was greatly appreciated.

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CHAPTER 1
INTRODUCTION
HIV Epidemic

The HIV epidemic is one of the greatest public health challenges of all time (CDC 2009). With the introduction of highly active antiretroviral therapy (HAART), death rates among individuals infected with HIV have reduced significantly. However, HIV incidence rates have continued to increase; every nine and half minutes another American is being infected with HIV (CDC 2010; NHAS 2010; TDSHS 2010). Consequently, despite significant advances in prevention and treatment, the impact of HIV on the US population has been substantial. In response, the U.S. government has implemented the National HIV/AIDS Strategy for the United States (NHAS), which has three primary goals: 1) reducing the number of people who become infected with HIV, 2) increasing access to care and optimizing health outcomes for people living with HIV, and 3) reducing HIV-related health disparities (NHAS 2010).

The prevalence and severity of HIV varies geographically (Oppong & Harold 2009; TDSHS 2010). Although everyone has a biological potential to contract HIV, certain factors make some geographical areas more vulnerable to infection than others (TGAPC 1992; Oppong 1998; NHAS 2010). Therefore, the environment in which a person lives is an important factor in their risk of exposure and disease, in particular HIV (Meade & Earickson, 2005; Oppong & Harold 2009).

The spatial pattern of HIV prevalence in the United States is intriguing. The South comprises only 35 percent of the nation's population, but 40 percent of all persons living with HIV/AIDS (PLWHA) reside in the South (CDC 2007). Furthermore, in 2007, the South accounted for 46 percent of all new AIDS cases and 50 percent of AIDS related deaths (CDC

2009). The geographic region of the United States referred to as “The South” is located in the south-eastern quadrant of the US and is comprised of sixteen states and the District of Columbia; those sixteen states are: Alabama, Arkansas, Delaware, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, and West Virginia. These seventeen entities are well accepted as the geographic classification of the United States South; the CDC and the Department of Justice use this geographic definition.

HIV among Special Populations

Throughout the country, but particularly in the South, prisons have experienced the brunt of the HIV infection epidemic. In fact, HIV infection constitutes a major health problem in the prison system. In 2005, in the United States, the HIV rate was more than 2.5 times higher in prison inmates than in their non-incarcerated counterparts (Maruschak 2005). With 44 percent of all state prisoners in the United States, the prison population is disproportionately higher in the US South. While only comprising about 7 percent of the US population, Texas has 12 percent of all state prisoners in the nation (Mergenhausen 1996).

The state of Texas is the most populated state in the south, and there is a dramatic disparity between the HIV rate of incarcerated populations and the general public. In fact, HIV prevalence rates have been estimated to be fifteen times higher among inmates in Texas than the general population (Baillargeon et al 2004). Moreover, within the past five years, the number of Texans living with HIV has increased thirty percent, and continues to rise (TDSHS 2009). Because HIV varies spatially, place characteristics are crucial for understanding of the geography of HIV and related health disparities across the state.

Study Objective

This study examines the relationship between the geographical locations of Texas Department of Criminal Justice (TDCJ) prison units and HIV prevalence rates in Texas. Correctional health affects public health. In 1996, the United Nations Commission on Human Rights stated, “Prisoners are the community. They come from the community, they will return to it.” Consequently, diseases acquired by the incarcerated population return to the community as well and become a public health concern. Previous research suggests that prisons may be fueling the spread of HIV in the general public; however, the effect of the geographical location of prisons on the HIV rate among the non-incarcerated population has not been studied.

The purpose of this study is to help public health decision makers identify areas that should be targeted for increased HIV surveillance, intervention and treatment. Thereby, increasing testing rates which in turn, facilitate early detection and help reach the goals set forth by the NHAS.

CHAPTER 2

CONCEPTUAL AND THEORETICAL FRAMEWORK

The Triangle of Human Ecology

The triangle of human ecology, Figure 2-2, provides a conceptual framework to explain the spatial patterns of disease. It posits that a person's vulnerability to disease is attributable to three factors – population, behavior, and habitat. Population refers to biological and human characteristics of people, behavior refers to observable culture such as choices and activities, and habitat refers to the environment in which people live. These three factors vary spatially and can be used to examine the geographic variation of disease.

This study focuses on the habitat leg of the human ecological triangle. Habitat, defined as the environment within which people live, comprises of three parts – natural, built, and social – that vary geographically (Meade and Earickson 2005). The geographic variation of environments and the factors that comprise them may be the most crucial factor in explaining the spatial variation of disease. Diseases vary spatially as do environmental factors. Thus, the spatial variation of environmental characteristics influences the spatial distribution of disease, and makes some places more vulnerable to disease than others.

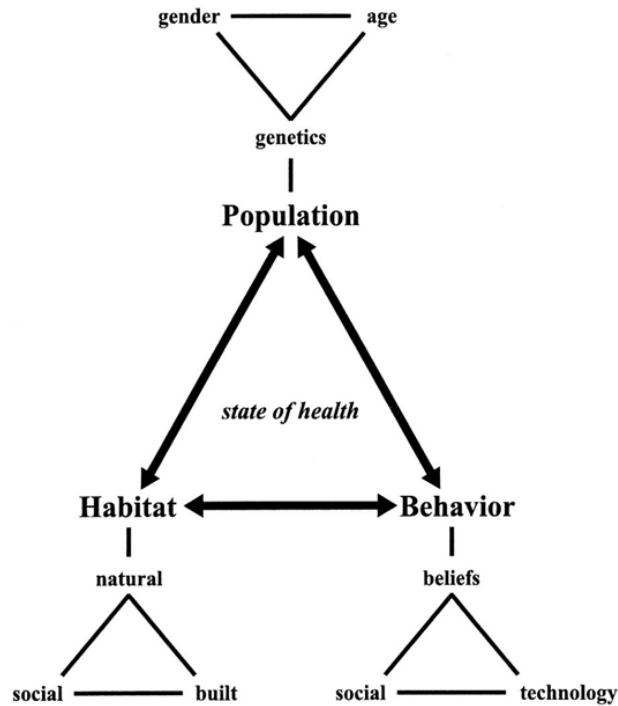


Figure 2-1 *The human ecology triangle. (Adapted from Meade and Earickson 2005.)*

Place Vulnerability Theory

Place vulnerability theory argues that adverse life circumstances, such as disease, do not affect all places uniformly, and that vulnerability to disease is inevitably tied to specific places. The environment, and the place characteristics that comprise it, can shape the spatial patterns of disease, and influence a person’s vulnerability to disease. Physical, social, economic, and other factors that make people more vulnerable to disease differ geographically (Oppong and Harold 2009).

The social environment in which one lives consists of social and cultural groups, their relationships, and the communities in which they are embedded. A person’s social environment substantially influences their vulnerability to disease, and is an imperative aspect in

understanding the geography of HIV because socially-constructed environments create circumstances in which people come in contact with this disease-inducing agent.

The geographic distribution of HIV illustrates how the social environment influences disease risk and distribution. Culture and social norms of acceptable behaviors are rooted in place and influence a person's environment (Gesler and Kearns 2002; Mills et al. 2001). A neighborhood's physical and social characteristics influence health by shaping choices and behaviors (Robert Wood Johnson Foundation Commission to Build a Healthier America 2009, 86).

The behavioral processes that facilitate the transmission of HIV infection can be mitigated by factors such as socio-economic status, which vary spatially. Places where high risk behaviors are socially acceptable have an increased vulnerability to HIV due to the spatial concentration of vulnerable people in that environment. Therefore, in order to gain some understanding of HIV patterns in Texas and ultimately accomplish the goals set forth by the NHAS, it is crucial to examine the geographical distribution of HIV infection, the reasons for these spatial patterns, and the possible factors putting certain places at a higher vulnerability for HIV infection.

The central thesis of this research is that there may be a relationship between the spatial distribution of HIV infection and the location of correctional facilities. If a prison itself is considered to be a vulnerable place containing a vulnerable population, and inmate health affects the health of the general public, then neighborhoods in close proximity to prisons could potentially be at a higher risk of exposure to HIV.

CHAPTER 3

LITERATURE REVIEW

HIV Patterns by Race/ Ethnicity in Texas

The estimated number of people living with HIV in Texas increases about six percent every year; the number of HIV cases and HIV rates has increased in all race and ethnic groups, however, not uniformly. (TDSHS 2007) Blacks are disproportionately affected compared to other race/ethnic groups. While comprising only 11.3 percent of the total population, Blacks account for 38 percent of HIV cases in Texas. Figure 3-1 demonstrates the racial disparities of Blacks compared with Whites and Hispanics by showing the actual number of people living with HIV on the left graph and the rate of people with HIV on the right graph.

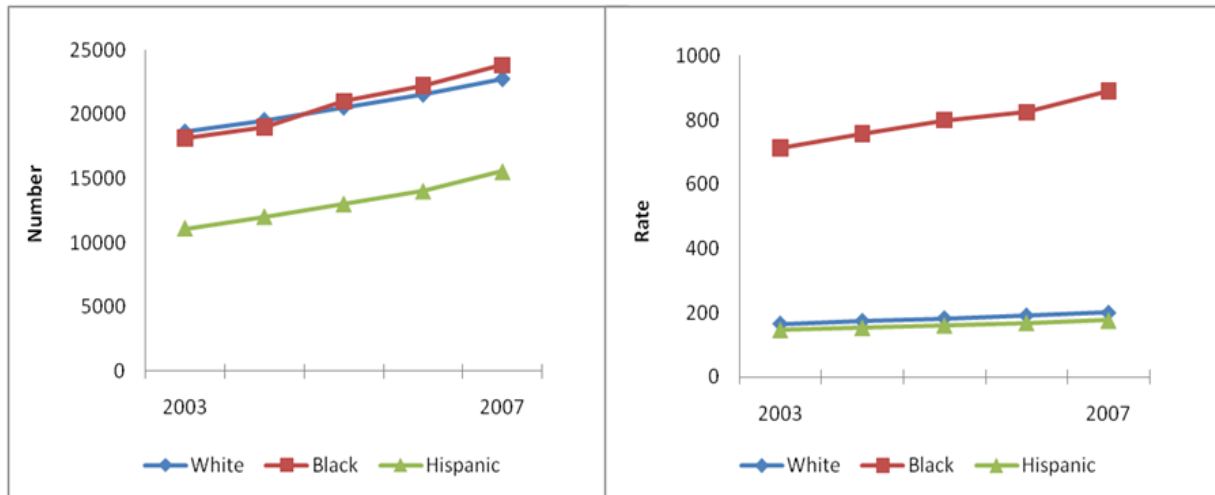


Figure 3-1 *The number and rate per 10,000 of persons living with HIV by race/ethnicity, Texas 2003-2007. (Created using data from the 2009 Texas Integrated Epidemiologic Profile for HIV/AIDS.)*

HIV Transmission Processes

Three modes of exposure account for almost all of HIV transmission in Texas – men who have sex with men (MSM), heterosexual sex (HRH), and intravenous drug use (IDU). Mode of exposure refers to the probable behavioral process in which a case came in contact with HIV. In the general population in Texas, half of the HIV cases are attributed to MSM; HRH accounts for 24 percent and IDU about 16 percent (TDSHS 2007).

In the TDCJ population, however, the pattern of modes of exposure is different. Although IDU only comprises the smallest portion of the mode of exposure in the general population, in the TDCJ inmate population with HIV, it is about sixty percent. This is not surprising given that an estimated seventy percent of the prison population use illegal drugs regularly either before or during incarceration (Hammett, Harmon, and Rhodes 2002, WHO 2007). MSM and HRH both account for about fifteen percent each.

Inmate Risk Factors

According to the Texas Department of Criminal Justice (TDCJ) Health Services Division, the HIV rate in the offender population is about 153 per 10,000; however, the Texas Department of State Health Services estimates that the state HIV rate is 25.8 per 10,000 (TDSHS 2009; TDCJ 2011). The inflated HIV rate in the incarcerated population is attributed to several factors that make this population more vulnerable.

Race, education, and drug use are three factors that influence an individual's vulnerability to HIV. Blacks comprise 37.3 percent of the inmate population, more than any other race; Blacks also are disproportionately affected by HIV. On average, inmates are less educated than the general public; the average number of school years completed by TDCJ inmates is 8.73. However, 80 percent of Texans have at least a high school education (TDSHS 2007). As

previously mentioned, drug use is a problem in this population; one in five TDCJ inmates incarcerated for drug use (TDCJ 2008).

When incarcerated, inmates are given a pamphlet about HIV but nothing is done to prevent the spread of the virus (Renaud 2002, 47). Furthermore, in Texas, only one-third of inmates who met the criteria for initiation of antiretroviral medications were actually on therapy (Baillargeon et al. 2000). This increases the possibility of transmission from one inmate to another.

TDCJ

In 2001, TDCJ was the largest prison system in the United States (Lichtenstein 2001). Today TDCJ is the second largest, behind California (West, William, and Greenman 2010). However, new prison construction has not been commensurate with the surging inmate population. As a result, Texas prison facilities have become some of the most crowded and dangerous in the United States (Momayezi and Stouffer 2002, 276). In a national survey of imprisoned criminals, five of the ten prison units with the highest reported rates of rape were TDCJ units (Ward 2008).

The Texas prison system is known for being one of the most dangerous, perverse, and corrupt prison system in the United States. The systems historically harsh treatment of inmates and its past corrupt administration are the cornerstones of this reputation (Renaud 2002; Momayezi and Stouffer 2002, 276).

TDCJ houses people who have committed an illegal infraction. Offenders tend to be more violent and brilliantly deceitful than the general public making the offender population dangerous; although the inmate is incarcerated, they are still a person. Operating this type of complex system and managing this complex population is a challenging task which TDCJ

diligently attempts to perfect every year by changing policies which does add to the complexity of this system.

Inmate Return to the Community

Risk behaviors in prisons like illicit drug use, and unprotected sexual activities can be conducive for HIV transmission. Because the vast majority of prison inmates are incarcerated for less than three years, transmission of HIV between prison inmates and then to members of the general community may occur at a high rate.

In Texas, upon release, inmates are given a set of civilian clothing and a one-way bus ticket. Once released from TDCJ, the former inmates are on their own – no guards, no warden, no walls. Inmates walk to the local bus station unaccompanied to wait for the bus (Lichtenstein 2001). Previous research suggests that some inmates sell these tickets for sex, drugs, money or other commodities. If an inmate sells their bus ticket the individual must stay in the area for a prolonged period of time to earn enough money to buy a new ticket for their destination.

The high-risk behavioral activities of released inmates increase the HIV risk of those who live in close proximity to the prison. Within one week of being released, the majority of inmates participate in high-risk behaviors, such as unprotected sexual activities and drug use, with the majority of events occurring on release day (Morrow et al, 2007). This continuation of high-risk behaviors increases the likelihood of transmission in the general public.

CHAPTER 4

DATA AND METHODS

This study was conducted at the zip code level using individually unidentifiable HIV infection incidence data for the 10-year period (1999-2009) obtained from the Texas Department of State Health Services, population data from the 2000 United States census, and prison locations from the Texas Department of Criminal Justice (TDCJ). The data includes all persons reported either with HIV or AIDS in Texas and specifies the zip code and county of residence at the time of diagnosis and if that diagnosis occurred during incarceration in a TDCJ facility. The HIV cases were aggregated to the zip code level to protect privacy and maintain confidentiality. Those cases that were diagnosed by a TDCJ facility were excluded from this study; therefore, rates and maps only depict the HIV/AIDS burden of the general public.

Table 4-1 *The data, sources of the data, and purpose of the data*

Data	Source	Purpose
HIV Cases	Texas Department of State Health Services (TDSHS)	Compute HIV rate
Population Data	2000 United States Census Bureau	Compute HIV rate for the general public
ZCTA Shapefile	ESRI	Map HIV spatial distribution and distance decay
TDCJ Locations	TDCJ Website (2009)	Analyze distance decay

Zip codes were matched to their correct zip code tabulation area (ZCTA) for mapping. There were 60,895 HIV cases matched to 1,748 ZCTAs. Due to incomplete data, out of state zip code, or invalid five-digit zip code 1,594 cases reported ($\approx 2.5\%$) were excluded from the analysis. The ZCTA shapefile used in this study was published by ESRI and is relevant for the time period between 2000 and 2007.

Mapping and Statistical Methods

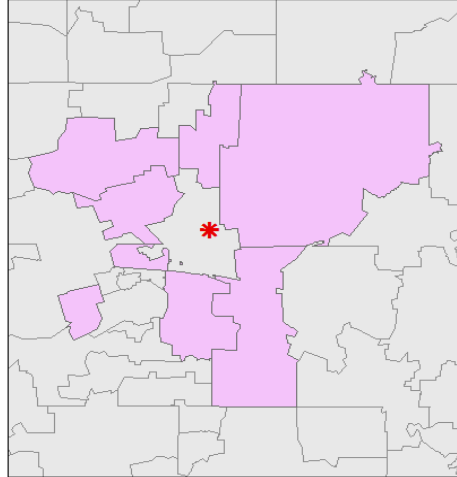
The spatial distribution of HIV infection was mapped using spatially adaptive filters, which computes smoothed rates of disease burden that can be mapped as a spatially continuous representation of HIV risk across Texas. This method is available in a web-based disease mapping framework, WebDMAP; cartographic representation of the rate was produced using ArcMap. In order to investigate the relationship between the spatial distribution of HIV infection and the location of TDCJ units in Texas, two different distance decay mapping methods were used – spatial buffers and concentric rings.

These two methods were chosen based on two different definitions in GIS of the term neighborhood. There are two commonly used spatial definitions of a neighborhood: adjacency and proximity (Cromley and McLafferty 2002, 139). Proximity, the relative distance between areas, is addressed by using buffers; adjacency, the sharing of a common boundary, is addressed by the concentric ring method. Figure 4-1 offers a theoretical example of adjacency and proximity (Cromley and McLafferty 2002, 140).

Table 4-2 *Mapping methods, purpose, and software employed*

Method	Purpose	Software
Spatially Adaptive Filters	Visual representation of the spatial distribution of HIV	WebDMAP; ArcMap
Distance Decay Methods:	Analyze the relationship between HIV rate and location of TDCJ units	ArcMap
1) Buffer Method	Examine distance decay of HIV rate away from TDCJ units	ArcMap
2) Concentric Rings	Examine distance decay of HIV rate away from TDCJ units	ArcMap
Student's T-test	Analyze characteristics of neighborhoods with TDCJ units	SPSS

Adjacency:
Geographic units share
a common boundary



Proximity:
Centroid is within 15
miles of a given
location

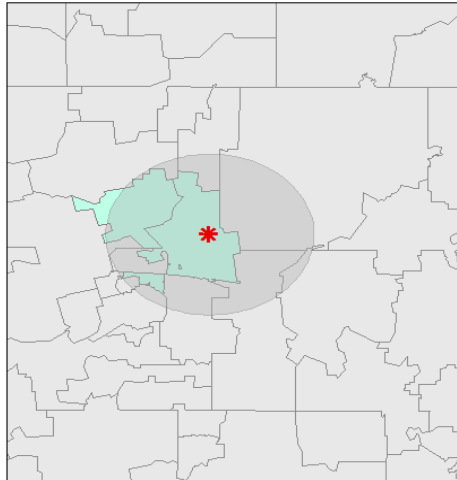


Figure 4-1 *View of the difference between proximity and adjacency. (Source: Adapted from Cromley and McLafferty 2002, 140.)*

Mapping TDCJ Units

The TDCJ website listed 117 prison facilities in 2009; all units were mapped with help from Google Earth. The data available from the TDCJ website lists an address for all units and a specific description of their geographic location. The prison unit locations were not found by street address geocoding the data due to three main issues: 1) the address listed is the mailing address, not the physical location of the unit, 2) the address listed does not exist according to the United States Postal Service, and 3) existing inaccuracies in the TIGER data used for street

address geocoding. However, using the location description provided, the exact longitude and latitude coordinates of each facility was determined using visual inspection in Google Earth. A point shapefile of all TDCJ unit locations was then created in ArcMap using these longitude and latitude coordinates. When mapped, the 117 TDCJ units are located in 74 ZCTAs.

Spatially Adaptive Filters

The spatially adaptive filters method was employed to create a visual representation of the geographic variation of the rate of HIV infection in Texas because these filters create maps with maximum spatial resolution that do not exaggerate the variability of the rates. This method creates a spatially continuous surface that alleviates misleading notions allowed by choropleth maps, which use arbitrary boundaries to display the spatial variation of disease burden. This mapping technique gives impression a uniform spatial distribution within the boundary and shows abrupt rate changes between geographic areas (Cromley and McLafferty 2002, 105). Spatially adaptive filters, also, provide higher statistical stability to rates and greater geographic detail when compared to conventional fixed-filters (Tiwari and Rushton 2005).

To implement the spatially adaptive filters method, a regular grid is generated over the entire study area; this study used a regular thirty mile grid. A rate is computed at each grid point. The spatial filter, centered over each grid point, expands until it has met the threshold value, t-value. When the specified t-value is met, the total number of cases within the filter becomes the numerator, and the t-value is the denominator. Due to the rural/urban spatial variation in Texas and the population in Texas with HIV infection, the t-value was set at 1,000 for this analysis. After calculating the HIV infection rate for each grid point using WebDMAP, the grid was converted into a continuous surface using the Kriging interpolation tool in ArcMap. For visual reference, the shapefile of the TDCJ units was overlaid on the HIV distribution map.

Distance Decay

The purpose of distance decay methods is to examine the relationship between the HIV rate of the general public and the distance from TDCJ units. This enables the study to investigate the relationship between neighborhoods and TDCJ facilities. The buffer method identifies neighborhoods in terms of proximity, the distance between two geographic entities; it uses the spatial proximity of ZCTAs to TDCJ facilities to analyze the distance decay of the HIV rate.

The concentric ring method defines neighborhoods based on whether or not geographic areas share a common boundary, or adjacency. This method uses adjacency of ZCTAs to one another to analyze the relationship between the HIV infection rate and distance from TDCJ units.

Buffer Method

This portion of the study identifies a neighborhood in terms of proximity. If an area is located within a certain critical distance of a specified geographic entity, it is in its neighborhood. For this research, the critical distance is fifteen and thirty miles of TDCJ facilities. Thus, two circular buffers, a fifteen mile buffer and a thirty mile buffer, were created around each of the 117 TDCJ units. The fifteen mile buffer defines which ZCTAs are located in TDCJ's neighborhood; the thirty mile buffer determines if there is distance decay in HIV among neighborhoods further away from the prison facilities.

The fifteen mile buffer is a circle with a fifteen mile radius that extends from each of the TDCJ units. All ZCTAs whose centroid – the geographic center of the ZCTA – was located within the fifteen mile buffer were selected, and the HIV rate was then computed for these areas by summing the number of HIV cases in all of the selected ZCTAs and dividing it by the total population of those same ZCTAs. There were 663 ZCTAs included in the fifteen mile buffer.

The thirty mile buffer covered the geographical space between fifteen and thirty miles of a TDCJ unit. All ZCTAs that had a centroid within this buffer were selected; a total of 605 ZCTAs. The HIV rate for the thirty mile buffer was then computed in the same way as the rate for the fifteen mile buffer.

Concentric Rings

In contrast to the buffer method, the concentric ring method uses the adjacency of geographic boundaries of ZCTAs to one another in order to create ring-like patterns. A series of three rings were created, Ring 0, Ring 1, and Ring 2. The first ring in this series of rings, Ring 0, comprises of all of the ZCTAs which contain one or more TDCJ units. The HIV rate for Ring 0 was computed by summing the number of HIV cases in that Ring (excluding the cases diagnosed in TDCJ facilities) and dividing it by the total population for the Ring. The next ring, Ring 1, was created by selecting all the ZCTAs that share a line segment with a ZCTA in Ring 0. Therefore, Ring 1 consists of all ZCTAs that are adjacent to a ZCTA that contains one or more TDCJ units. A rate was computed for Ring 1 in the same manner as Ring 0. To create the final ring in the concentric ring series, Ring 2, all ZCTAs that shared a line segment with Ring 1 were selected, and a rate was computed using the same equation as the other two rings.

Student t-Test

In order to analyze the neighborhood characteristics of the zip codes that contain or more TDCJ facilities, a simple t-test was run using the statistical software SPSS. Table 4-1 lists all the demographic and socio-economic variables used in the t-test and how the variable was computed; 2000 census data was used for this analyses. The zip codes were categorized as 1 if it had one or more TDCJ facilities and 0 if it did not have any TDCJ facilities. There were

seventy-four zip codes with one or more TDCJ units, and 1,789 zip codes without many TDCJ units. ($N_1 = 74$ $N_0 = 1789$)

Table 4-3 *Demographic and socio-economic variables used in student's t-test*

Variable	Computed
% Urban	(Urban Population in zip code/ Total Population in zip code)
% Black	(Total Black Population in zip code/ Total Population in zip code)
% White	(Total White Population in zip code/ Total Population in zip code)
% Hispanic	(Total Hispanic Population in zip code/ Total Population in zip code)
Median Income	The Median Income of the Zip Code

CHAPTER 5

RESULTS

HIV Burden in Texas

Figure 5-1 presents a map of the geographic distribution of HIV in Texas, using the spatially adaptive filters approach, overlaid with TDCJ units classified by maximum capacity. Upon inspection, there appears to be a visual correlation between the locations of TDCJ units and the areas with elevated rates of HIV, especially around the largest TDCJ units, denoted in red. The majority of these large units are located in areas with the highest rates of HIV in the state.

Areas that appear to be more vulnerable to HIV can also be identified. The more vulnerable areas are depicted by the darker colors, the less vulnerable areas are depicted by lighter color shades. Over all, the eastern portion of the state has a much higher prevalence of HIV infection. This may be due to the concentration of Blacks in this region of Texas since Blacks have much higher rates of HIV infection (CDC 2009). Most of western Texas exhibits relatively low rates of HIV. This pattern is most likely due to the predominantly rural white population in west Texas; rural populations tend to have lower rate of HIV than their urban counterparts.

This map also displays the spatial relationship between the HIV infection rate of the general public and the location of the TDCJ units. The higher rates of HIV prevalence found in areas in close proximity to TDCJ units suggest that these areas may be more vulnerable to contracting the disease. The two distance decay approaches employed by this study show that as distance increases from TDCJ prison facilities the HIV infection rate of the general public decreases.

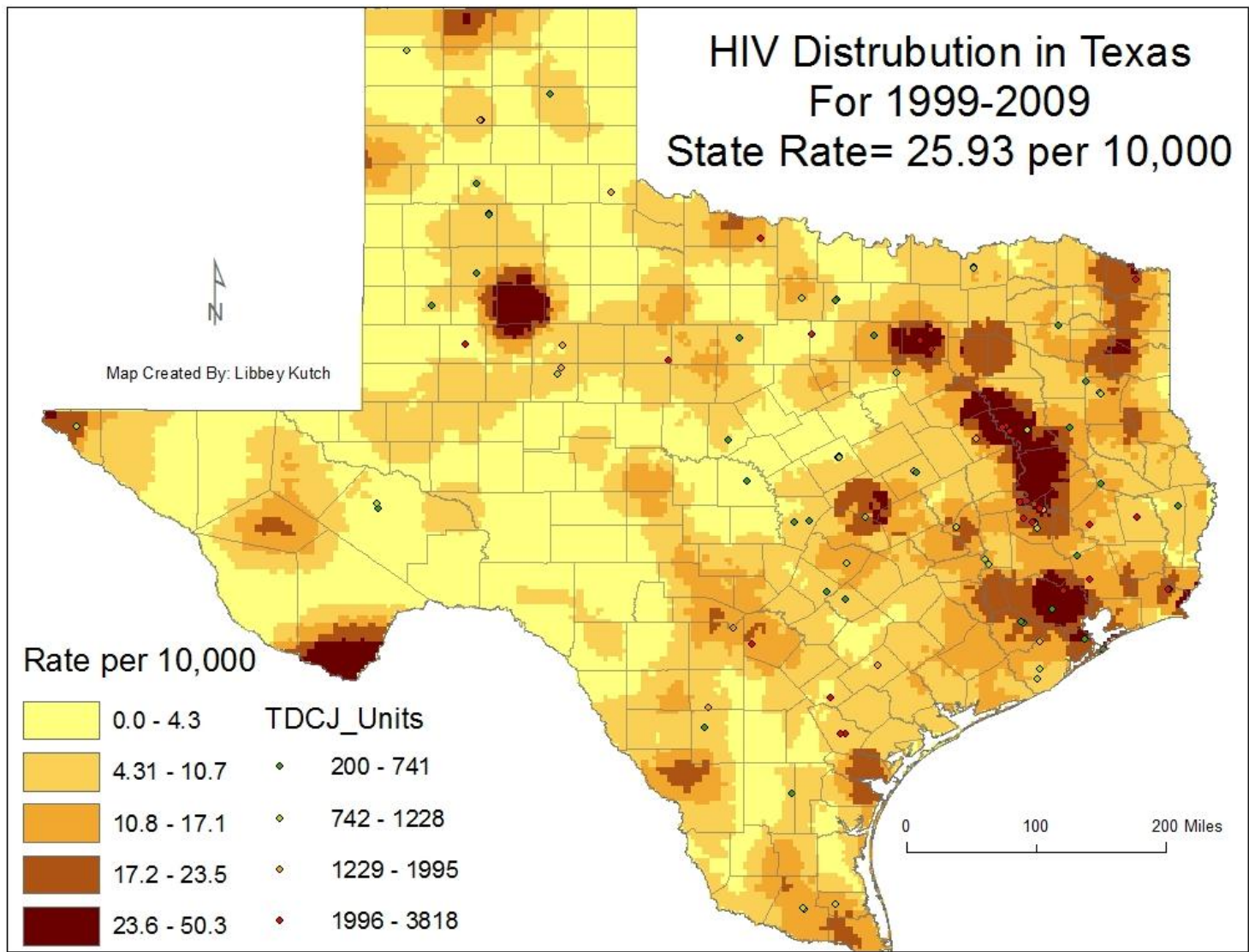


Figure 5-1 *The spatial distribution of the HIV burden in Texas.*

Distance Decay

Buffer Method

The buffer method analyzes HIV prevalence of neighborhoods close to TDCJ facilities based on proximity; here proximity was based on the distance between ZCTAs and TDCJ units.

Located within the fifteen mile buffer, there were 663 ZCTAs containing 47,824 HIV cases and a total population of 13,344,571; this yielded a rate of 35.84 per 10,000. A comparable 605 ZCTAs were located within the thirty mile buffer; however, those 605 ZCTAs only contained 10,084 cases. With a total population of 7,495,786, the rate computed for the thirty mile buffer was 13.45 per 10,000.

Table 5-1 *Buffer method results*

Spatial Summary	
State Rate	25.39 per 10,000
15 Mile Buffer	35.84 per 10,000
30 Mile Buffer	13.45 per 10,000

Table 5-1 presents the HIV rate computed both for the fifteen mile and thirty mile buffers, along with the computed state rate of 25.39 per 10,000. Figure 4-2 presents the map results of the buffer method. The darker color areas, which denote a higher HIV rate, represents the ZCTAs in the fifteen mile buffer; it also represents the geographic areas that are located in the same vicinity as one or more TDCJ units based on proximity. Clearly zip codes in the immediate vicinity of TDCJ units have much higher rates of HIV prevalence.

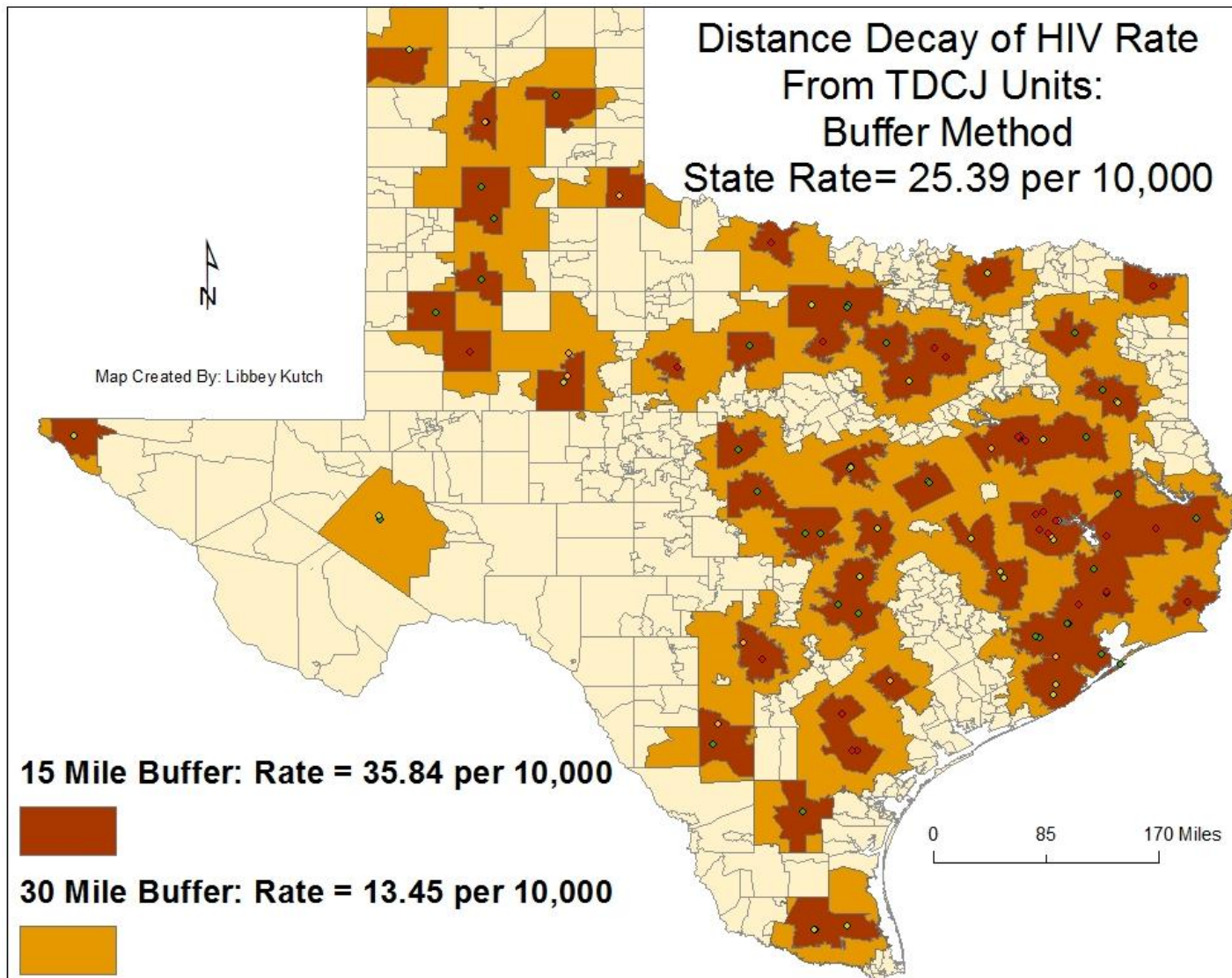


Figure 5-2 Distance decay using buffer method.

Concentric Rings

The concentric ring method is based on the adjacency of defined geographic boundaries. Seventy-four of the 1,748 ZCTAs used in this analysis contain one or more TDCJ units; these seventy-four neighborhoods with a total population of 1,394,011 constitute Ring 0. This ring contained 6,452 cases with a HIV rate of 46.28 per 10,000. The next ring, Ring 1 is comprised 413 ZCTAs that share a line segment with Ring 0; there were 10,100 cases and a total population of 4,441,965 yielding a rate of 22.74 per 10,000. The final ring in the concentric ring series, Ring 2, is consists of 576 ZCTAs with 16,212 cases and a population of 7,232,426, Ring 2 has a HIV rate of 22.42.

Table 5-2 *Concentric ring results*

Spatial Summary	
State Rate	25.39 per 10,000
Ring 0	46.28 per 10,000
Ring 1	22.74 per 10,000
Ring 2	22.42 per 10,000

In Table 5-2 is a chart presenting the rates for the three concentric rings; upon moving out though the tiers of rings, the rate decreases. The geographical representation of the concentric rings is displayed in Figure 4-4.

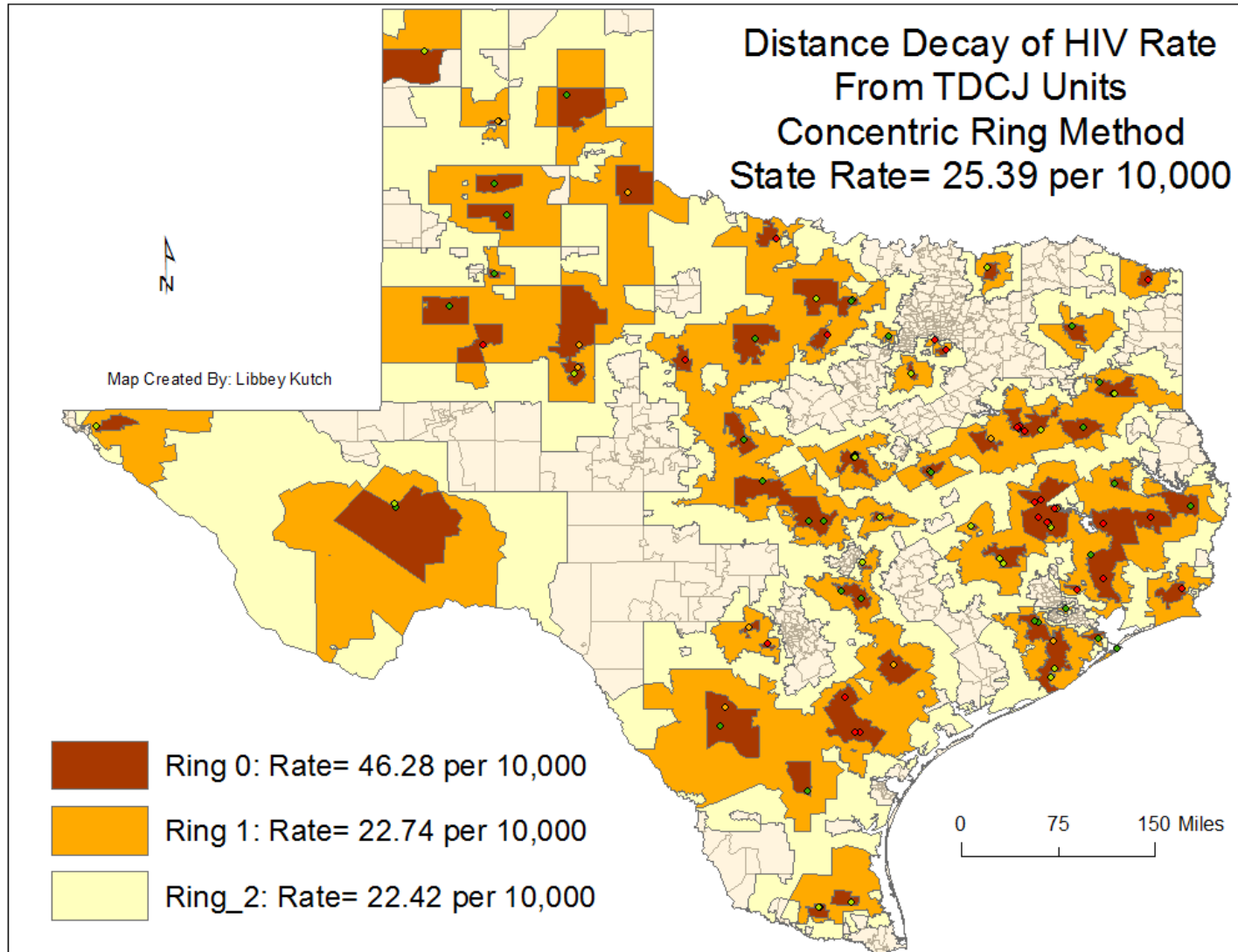


Figure 5-3 *Distance decay using concentric ring.*

Student's t-Test

A simple t-test was used to compare the demographic and socio-economic characteristics of ZCTAs with or without TDCJ units. The results of this statistical analysis can be seen in Table 5-3. ($N_1=74$ $N_0=1789$) The results suggest that zip codes with one or more TDCJ units are predominantly Black, urban, and have a low median income. These zip codes are not impoverished areas due to the low-paying jobs the TDCJ provides in these areas.

Table 5-3 Results from t-test ($N_1=74$ $N_0= 1789$)

	TDCJ	Mean	Sig. (2-tailed)
%Urban	1	63.386	< 0.01
	0	41.7708	< 0.01
%White	1	68.652	< 0.01
	0	78.633	< 0.01
%Black	1	16.686	< 0.01
	0	8.334	< 0.01
Hispanic	1	28.812	.706
	0	24.630	.706
Median Income	1	33411.01	< 0.01
	0	37906.9	< 0.01

CHAPTER 6

DISCUSSION

The results of this study show a negative relationship between distance from TDCJ units and the HIV rate of the general community. As distance from the TDCJ unit increases the HIV infection rate decreases. Thus areas immediately surrounding TDCJ units have much higher rates of HIV than areas much farther away. The question is why?

Disease diffusion depends on exposure and, although HIV infection is transmitted through behavioral practices, socially-constructed environments create the circumstances in which individuals become exposed to disease-causing agents like HIV. Culture and social norms are rooted in place, and the behaviors that characterize local neighborhoods create environmental conditions conducive for exposure to HIV; thus, resulting in the spatial variation of HIV. The environment in which a person lives does matter; it affects the health of that individual. Understanding environmental factors of an area is important to the geographical distribution of HIV.

This analysis examined at prison units as an environmental factor in neighborhoods. Due to the high rate of HIV the incarcerated population, the frequency of high-risk behaviors, and the lack of knowledge about inmates' departure from the area, neighborhoods with one or more TDCJ units could be more vulnerable to exposure to HIV. Inmates' health behaviors in the community contribute to the health of the general public, and there is a need to learn more about the geographical context of inmates' health behaviors; where this vulnerable population participates in behavioral processes that transmit HIV is a public health concern. The geographic concentration of vulnerable people creates vulnerable environments. If inmates, once released, stay in the general neighborhood, then these areas could be more vulnerable to HIV due to the

influx of vulnerable peoples. The results of this study support the idea that the areas around TDCJ units are at a heightened vulnerability.

The results of this study indicate that areas closer to TDCJ units have higher rates of HIV and, therefore suggest that these neighborhoods are more vulnerable. Thus, these facilities are a part of a vulnerable environment. This is not to say that TDCJ prison facilities necessarily create vulnerable environments. This is an example of the classic question, “Which came first, the chicken or the egg?” Do TDCJ facilities induce increased vulnerability to HIV infection, or do TDCJ facilities locate in already vulnerable environments?

There may not be a simple answer to this question. Although these facilities house and release a vulnerable population, they also are an environmental factor that many people do not want in their neighborhood. Prison facilities are considered to be an undesirable nuisance that most home owners do not want nearby. The term, NIMBY, Not In My Back Yard, characterizes this perception. Consequently, NIMBY facilities tend to devalue surrounding properties. More affluent communities are able to keep NIMBYs away through legal action but poorer communities are typically unable to prevent them. In fact, usually, poor communities actively court such facilities through special incentives such as tax breaks in the hope that they may bring employment and other economic benefits (Eason 2010).

Moreover, prisons tend to be established in predominantly rural areas with concentrated economic disadvantage (Eason 2010). Impoverished populations usually have higher rates of communicable diseases such as HIV; a prison facility may thus exacerbate the vulnerability and lead to much higher rates of HIV. Thus, whether TDCJ units are creating vulnerable areas, or tend to locate in vulnerable areas is not easily answered. In attempting to address the issue, it is

necessary to compare the neighborhood characteristics of zip codes with TDCJ units to those without TDCJ units, as well as analyze the history of the Texas prison system.

TDCJ Neighborhood Characteristics

The results suggest that neighborhood environments in which TDCJ has established one or more facilities are predominantly urban. However, as previously mentioned, these areas have not always been urban. Prison facilities tend to locate in rural areas. In the past twenty-six years, Texas has built the most rural prisons out of all the states; the majority of TDCJ facilities were established in rural areas by acquiring large farms. (Eason 2010) Due to population growth and population shift these once rural areas have seemed to evolve into are small urban areas.

Previous research suggests that prisons are clustered at the county and town level, therefore, once one prison is located in an environment the possibility of another one being built in the same environment increases (Eason 2010). This could possibly a reason for the rapid urbanization of these rural areas. When multiple units locate in the same area the amount of jobs in the area increases; it also increases economic productivity and opportunity. The rising economy of these neighborhoods provides a reason for others to move to the area resulting in urbanization.

Having multiple units and an increase in urbanization could potentially increase the area's vulnerability as well. Evidence shows that HIV is a predominantly urban disease, and that the urban environment creates a cultural environment which creates an increase of exposure to the disease.

The majority of TDCJ facilities were established in rural areas by acquiring large farms. A large proportion of TDCJ units are located near the site of Steven F. Austin's colony in the

historic cotton slavery belt in counties like Brazoria, Fort Bend, Polk and Walker. These four counties alone contain nineteen TDCJ units. In the 1980's, Texas began to establish facilities outside of the cotton belt.

Before the 1990s the Texas prison system was a major public issue. The system was characterized by mismanagement, corruption, and poor treatment of inmates. TDCJ was established in 1989 to address these problems and changes to policies and procedures have been made yearly in this endeavor. However, the Texas prison system still has a reputation of being one of the most dangerous, perverse, and corrupt prison systems in the United States (Renaud 2002). The system's historically harsh treatment of inmates and its past corrupt administration are the cornerstones of this reputation. Operating this type of complex system and inmate population is a challenging task which TDCJ diligently attempts to perfect every year.

CHAPTER 7

CONCLUSION

This study identifies geographical areas that appear to be more vulnerable to the HIV infection based on the high disease rates in these locations. Vulnerable environments and the factors and place characteristics that comprise them are complex due to the multiple variables that affect them. Unraveling the complex configuration of these variables responsible for the degree of vulnerability to HIV in these areas is crucial to developing effective policies and programs for prevention and control. Increased attention should be directed towards the factors that comprise community environments. The next step in this research is identifying characteristics of neighborhoods in close proximity to TDCJ facilities with high HIV infection rates.

Limitations

This analysis does have limitations. One of the main limitations is the assumption that there is uniform distribution of the population and HIV cases. The HIV prevalence and population data were aggregated to ZCTAs which assumes that the distribution of this data is uniformly distributed across this geographical space. In reality, this is not the case. For example, there may be some areas that have a higher population density, resulting in a concentration of disease burden. However, due to privacy reasons, mapping individual locations is not possible. Another limitation is the failure to identify the five-digit zip code. In the available data set, some listed zip codes did not have five digits or were unrecognizable as a Texas zip code. Therefore, these reported HIV cases could not be included in this study.

Implications for Future Research

The analyses done in this study provides evidence that suggests the location of correctional facilities impacts the health of the surrounding area. These geographic areas have not been previously viewed as HIV vulnerable places; acknowledging these neighborhoods as such is important to HIV surveillance. Educating these vulnerable communities about HIV and the behavioral processes that facilitate transmission is a crucial factor in slowing the rising incidence rate of HIV.

Correctional health affects public health. Discharge planning and continuity of health care programs are essential for reduces the HIV rate. Correctional intervention benefit, not only inmates but, the general population as well. Discharge planning for inmates with HIV is a critical step in the slowing the spread of the disease. Prison medical services, in collaboration with community health services, need to monitor these inmates after release, provide medical and psychological services, and encourage them to continue with treatment because patient follow-up is a key factor for HIV surveillance intervention and treatment. Although providing these services would be costly, they are important. Considering the high-rate of HIV in the incarcerated population, prisons are important settings for targeting a high-risk population, and educating said population and providing treatment as well. Prison authorities should take all necessary measures to provide inmates with easy access to HIV-related prevention, information, and education (WHO 2007).

The purpose and practical utility of this study is in identifying vulnerable areas that should be targeted for increased HIV surveillance, intervention and treatment. Whether these areas were vulnerable before or after a correctional facility was located in the area, or if these environments are vulnerable to HIV for another discovered reason, does not matter. This

analysis indicates that these neighborhoods are vulnerable environments. Identifying vulnerable areas may facilitate early detection of potential new cases and help reach the goals set forth by the NHAS.

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