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GEOGRAPHIC INFORMATION SYSTEM: A TARGETED APPROACH TO SYPHILIS ELIMINATION

June Morrison-Jones

APPROVED:

Ximena Cuadra-Rojas
Major Professor

Sue G. Lurie, Ph.D.
Committee Member

Committee Member

Ximena Cuadra-Rojas
Track Director

Dean, School of Public Health

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Syphilis is a sexually transmitted disease that has long caused a heavy public health and economic burden in the United States. With syphilis rates reaching their lowest recorded levels in the United States, Health officials are calling for an increased effort to eliminate the disease. In the United States, syphilis is also now extremely concentrated geographically, facilitating effective intervention. Most syphilis cases disproportionately affect a small portion of the population. African Americans who live below the poverty level, have limited access to health care, and have a number of social problems are often affected. This study examines the geographic distribution of syphilis and factors associated with syphilis transmission in Dallas County. The study used the techniques of geographic information system, principles of epidemiology, sociocultural linkages (race, ethnicity, and gender) between demographic factors and syphilis, to gain insights into the geographic distribution of syphilis among the affected groups, and intervention strategies for syphilis elimination were developed. These suggestions should assist the Dallas County Health Department in launching an effective syphilis elimination program.

Results showed that zip codes with high incidence of cases were generally adjacent to each other. In addition, statistically significant results confirmed that poverty, minority-race ethnicity and geographic core areas are factors associated with the transmission of syphilis.

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June Morrison-Jones, M.A.

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INTRODUCTION

PURPOSE OF THE STUDY

Syphilis is a sexually transmitted disease (STD) caused by the bacterium *Treponema pallidum.* Transmission of syphilis occurs through direct contact with syphilitic lesions during vaginal, anal, or oral sex. Pregnant women with the disease can pass it to the babies they are carrying.

Syphilis rates in the United States have reached their lowest recorded level and health officials recognized a tremendous opportunity for an increased effort to eliminate the disease (Aids Alert, 1998). Nevertheless, this significant achievement in lower syphilis rates is not universal, and in some areas, particularly southern United States, rates are still high or remain unchanged. Where syphilis does persist in the United States, it disproportionately burdens African Americans living in poverty. The disease is highly concordant with HIV due to its similar risk factors (Aids Alert, 1998). Several studies document that genital ulcer disease such as syphilis increases the likelihood of acquiring HIV infection (Aral, 1999).

The division of Sexually Transmitted Diseases (STD) of the Centers for Disease Control (CDC) has adopted a National Plan to eliminate syphilis from the United States (CDC, 1999). This plan has outlined five strategies that are critical for eliminating syphilis. These are: strengthened community involvement and partnership, outbreak response, enhanced surveillance, expanded clinical laboratory services and enhanced health promotion.

In a local response to syphilis elimination, the Sexually Transmitted Diseases unit of Dallas County Health and Human Services department is developing a syphilis elimination initiative focusing on geographic areas (i.e. zip codes, streets) with high rates of syphilis. The objective of the initiative is to assess the geographic distribution and transmission of syphilis in core areas (zip codes and streets) and utilize a more targeted intervention aimed at elimination. This approach to syphilis elimination was limited in scope. Specifically, this research project will consider additional factors influencing the distribution and transmission of syphilis in Dallas County.

The purpose of this study is to use the techniques of geographic information system (GIS), principles of epidemiology, sociocultural linkages (race, ethnicity, and gender) between demographic factors and syphilis to gain important insights into the geographic distribution of syphilis among the affected groups. In addition, community intervention strategies for syphilis elimination will be discussed. This thesis will begin with a brief discussion of the importance of the research, followed by a review of the rationale for syphilis elimination. Chapter two will present the research method, research background and a brief discussion on the application of geographic information system in

health research. The final chapter includes a discussion of the research findings, statistical analysis, recommendations for community intervention, strategies for syphilis elimination, implications for further study and limitations of this research.

BACKGROUND AND IMPORTANCE OF THE RESEARCH

Global disease eradication and disease elimination from localized areas are increasingly being promoted and studied as public health approaches for selected infectious diseases (Dowdle et al, 1988). However, when a campaign fails, the field can fall into disrepute. Syphilis, identified in the 1930s as the principal public health problem then facing the United States (Parran, 1937) was the target of elimination efforts in the 1940s, and the 60s. These campaigns reduced rates substantially but did not eliminate sustained domestic transmission. Syphilis now has been eliminated from almost 2,300 (73 percent) United States counties. In 1996 more than 84 percent of primary and secondary cases were reported from only 15% of U.S. counties and half of all new cases of syphilis were concentrated in 38 (1.2 percent) U.S. counties. Urban and rural areas in the South and several major cities throughout the U.S. continue to be foci of the epidemic. Non-Hispanic, black Americans are particularly affected, with syphilis rates more than 50 times higher than among non-Hispanic white Americans (MMWR, 1998). The question therefore, is: why the United States Public Health Service is targeting syphilis for national elimination?

Syphilis can be classified into stages. The first stage (primary syphilis) is marked by the appearance of a small painless red pustule on the skin or mucous membrane between 10 to 90 days after exposure. The second stage (secondary syphilis) begins six to 12 weeks after infection. The obvious feature is a skin rash, which may last for months. The third stage (tertiary syphilis) may develop for 3 to 15 years or more. This is characterized by the appearance of soft tumors. Latent syphilis may last for a few years or for the rest of a person's life. Congenital syphilis results from prenatal infection.

The emergence of the human immunodeficiency virus (HIV) epidemic has greatly amplified the importance of syphilis as a health problem in the United States. Syphilis causes genital ulcers, which dramatically increase the likelihood of sexual transmission of HIV. Syphilis has helped to fuel the rapidly emerging HIV/AIDS subepidemic in young African American women in the southeastern United States (Wortley et al 1997). In addition, syphilis can be a severe opportunistic infection with catastrophic neurological impact in HIV-infected immunosuppressed persons (Gordon et al, 1981).

Congenital syphilis is a potentially fatal disease that also can cause severe, persistent neurologic separation. It affected more than 3000 infants annually during the peak of the recent U.S. syphilis epidemic of the late 1980s and early 1990s (CDC, 1999).

RATIONALE FOR SYPHILIS ELIMINATION

Syphilis elimination would provisionally mean no on-going endemic transmission of the disease within a community or jurisdiction. In the current epidemiological context

of syphilis in the United States, we can identify four main fundamental public health reasons for considering an elimination effort for domestic transmission of syphilis.

1. The important cofactor effect of syphilis as a facilitator of sexual transmission of HIV infection;
2. The substantial disparity in health status between African Americans and other Americans;
3. The human and economic costs of congenital syphilis;
4. The current epidemiological vulnerability of syphilis (the need to increase understanding of current trends in epidemiology to help in syphilis prevention/elimination).

Syphilis elimination has far-reaching implications for other health conditions

Elimination will improve community health status by removing one important factor that facilitates human immunodeficiency virus (HIV) transmission and by preventing spontaneous abortions, stillbirths, and multi-system newborn disorders caused by congenital syphilis (Fleming, 1999). A recent cost analysis found that syphilis causes a significant public health burden at a considerable cost to society. More than $966 million in direct and indirect costs is spent each year in the United States as a result of syphilis, including adult syphilis ($185.5 million), congenital syphilis ($28.5 million), and HIV attributable to syphilis ($752.2 million) (Chesson et al, 1998).

Syphilis elimination will decrease the racial disparities in the health status of Americans

The continuing United States syphilis epidemic signals the failure of the basic public health systems to meet the needs of some of this nation's most disadvantaged communities. In 1998, the Department of Health and Human Services announced a national initiative to eliminate racial disparities in the health status of Americans. Syphilis elimination will be a leading edge in this effort. It will strengthen public health capacity in communities in greatest need and close one of the most glaring gaps in health status in this country, thereby improving the overall health status of many Americans (Public Health Reports, 1998). Few gaps in the health outcomes currently outstrip the approximately 40-to-1 ratio between blacks and whites in reported primary and secondary (P&S) syphilis in 1997. Some of this gap is attributable to differential reporting of syphilis among blacks to public health agencies. However, most of the differential burden of syphilis reflects the multiplicative effects of differences in poverty, health awareness, access to and acceptability of health care services, segregated sexual networks, and judgmental attitudes of providers with regard to STDs (Laumnann et al, 1999). This extraordinary differential in a disease that is so susceptible to basic medical care is one of the most glaring examples of existing gaps in minority health status.

Since African Americans disproportionately bear the syphilis burden, elimination efforts will reduce racial disparities in syphilis by providing better access to high quality, culturally sensitive preventive and care services. To achieve elimination, referral networks must be established to increase access to primary care, prenatal care, and other

services such as drug treatment, which in turn will improve the health status of African Americans more broadly. Health education and communication are methods that can also be used for prevention of syphilis.

Syphilis elimination efforts can strengthen the capacity to improve community health

Few diseases have more complex, stigmatizing social determinants and ramifications than does syphilis. These include the sexual transmissibility of syphilis, its association with prostitution and substance abuse, and the ethnic and socioeconomic disparities in its distribution. Stigmatization complicates every aspect of its control and elimination (St. Louis et al, 1996). Many in the African-American community would consider that even successful elimination of syphilis might not warrant the effort unless it can simultaneously help remedy the public health legacy of discrimination and empower communities to deal more effectively with infectious diseases. The legacy of the Tuskegee syphilis study will have to be addressed in the elimination efforts. It will be important to involve blacks in the planning stages of proposed research, which might help to overcome the negative effects of the legacy. In these communities, syphilis elimination efforts will be the entry point for strengthening the capacity to improve community health more broadly by enhancing control of infectious diseases and augment other health services. Because of the implications for improving overall health status, these events should alert and motivate communities to take prompt corrective action.

Syphilis elimination is biologically and epidemiologically feasible

The current epidemiology of syphilis, combined with its basic biological characteristics, make it possible to eliminate this disease in the United States. Syphilis meets all of the basic requirements for a disease susceptible to elimination. The infection can be diagnosed and cured with simple, in-expensive, and widely available tests and antibiotics. There is no animal reservoir; humans are the only host, no evidence of antibiotic resistance, and a long incubation period that favors case findings and epidemiologic treatment before further transmission occurs. Thereby, the epidemiology and biological characteristics of syphilis make elimination feasible (Hook, 1996).

Based on the repeatedly observed seven-to ten-year syphilis cycle, there is a narrow window of opportunity to eliminate syphilis while cases are still on the decline. The last epidemic peak occurred in 1990, when the highest numbers of syphilis cases (50,578) and rates (20.3/100,000 population) in forty years were recorded (See Appendix A – P&S Syphilis Cases in US. 1970 - 1998). This increase in cases was due to sudden increase in cases in heterosexual, lower socio-economic black men and women (Drusin, 1996). It was noted that approximately 10-12% of these patients were adolescents (MMWR, 1993). As a result of the large increase of infection in women, there was a comparable rise in congenital syphilis in infants less than one year of age (MMWR, 1994). The national rate for congenital syphilis peaked in 1991 at 107.3/100,000 live births and decreased to 20.6/100,000 live births in 1998. By 1998, the number of primary and secondary syphilis cases had declined by 86% to 6,993 and the rate, 2.6/100,000 population, was the lowest ever recorded in the United States (CDC

Statistics, 1999). The decline in syphilis can be attributed to a public strategy that included public education, screening, clinical treatment, partner notification, clinical advance of penicillin therapy and other factors (St. Louis, 1995). The sharply reduced over-all number of syphilis cases complimented by an extremely focal distribution makes syphilis uniquely vulnerable to eliminate. Most syphilis cases are geographically concentrated in Southern states (4,810 or 69% of P&S cases in 1998), and many occur in large metropolitan areas (3,523 or 50% of P&S cases in 1998). In 1998, over 50% of P&S syphilis cases were reported from 28 (<1%) United States counties, the majority of which are in the South. Nearly 78% (2,431) of the nation's counties reported zero cases of syphilis in 1998 (See Appendix A – P&S Syphilis Cases in US. 1970 - 1998).

Syphilis elimination a local effort

The number of cases in Texas of primary and secondary (P&S) syphilis has declined dramatically in the last eight years, from over 5,000 cases in 1991 to less than 500 in 1998 (Texas Department of Health, 1998 report, see Appendix B). Statewide, 430 cases of primary and secondary (P&S) syphilis were reported in 1998. There was a 36% decrease from cases reported in 1997. The number of primary and secondary syphilis cases reported in 1998 was one-tenth the number reported in 1991. The overall state rate is in 1998 for P&S was 2.2 cases per 100,000 population-the lowest rate since the late 1950s. Despite the decline, certain geographic areas such as Dallas and Houston continue to experience high rates of syphilis. In Dallas, South Oak Cliff (121.7/100,000) and South Dallas (168.9/100,000). Dallas County continues to meet the Center for

Disease Control and Prevention's definition of a High Morbidity Area (HMA). The reasons for continued high morbidity areas can be possibly attributed to high crime (murders, robberies, aggravated assaults) rates (Dallas Morning News, 2000), and other factors such as high rates of unemployment, drug use and poverty. Dallas County reported 124 cases of primary and secondary syphilis in 1998, one-tenth of the number of cases the county reported in 1991 and 29% of Texas morbidity in 1998 (Dallas County Health Department, 1999). Of the cases reported in 1998, 96 cases (77%) were among African Americans. While the case rates for whites and Hispanics were much lower, 1.4 and 1.8 per 100,000 respectively, for African American is 23.3 per 100,000. Primary and Secondary syphilis has declined over time among all racial/ethnic groups. Between 1994 and 1996, the number of cases remained fairly level among African Americans, with around 200 cases per year, dropping to 123 cases in 1997 and 96 cases in 1998. In Dallas County, Texas age-specific case rates between African American primary and secondary syphilis cases exhibited the highest case rate in 1998, among those aged 20 to 24 (62.7 per 100,000). The second highest rate was among those 35 to 39 (48.3 per 100,000) followed by African Americans aged 30 to 34 (48.0 per 100,000) (Dallas County Health Department, 1999). African American females and males were found to have the highest rates in age range 20 through 24. The extremely high case rate for both sexes indicates the continuing severity of the problem of Primary & Secondary syphilis among young African Americans in Dallas County and the state.

The Sexually Transmitted Diseases unit of the Dallas County Health Department has launched a local syphilis elimination initiative in response to the high syphilis cases in certain geographic locations in Dallas. In a recent Dallas County STD 1999 report, it was reported that primary and secondary (P&S) syphilis morbidity in Dallas County has increased in 1999. However, the increase might have been as a result of the STD program's response to a change in morbidity that occurred early in the year. It is encouraging that the increase is in Primary & Secondary cases only and not in latent cases or total syphilis cases. Total Primary & Secondary cases increased by 26 for a 21.0% increase when rates for 1998 and 1999 are compared (see Appendix B – Comparison of syphilis morbidity in Dallas County for January to December 1998 and January to December 1999). Early latent cases decreased by 23 (-5.7%), late latent cases decreased by 49 (-24.5%), congenital cases decreased by 20 cases (-87.0%) and total syphilis decreased by 66 cases for an 8.8 % decrease. Dallas County Health STD department has implemented measures to identify more cases of syphilis with the objective of eliminating this disease. These are extended clinic hours for better access to the STD clinic, and enhanced surveillance (such as intensified screening in correctional facilities). Because of these measures the increase in Primary & Secondary syphilis cases were noticed. While rates are low and the disease is focal a concerted effort could contribute to the possible elimination of syphilis in these areas.

LITERATURE REVIEW

Epidemiology of Syphilis

In the United States, historically and currently, the age and gender composition of African-American and Hispanic populations are more conducive to higher STD rates than those of the white population (Ehrhardt et al, 1991). National trends for syphilis, more than for any other reportable STD, show a high correlation with race, ethnicity and socioeconomic status (Leonard, 1999). In 1991, the rate of primary and secondary (P&S) syphilis among heterosexual African Americans was 11-fold higher than the rate among Hispanics and 62 times higher than the rate among European Americans (Mooran, 1993).

Syphilis is geographically clustered (Mortality Morbidity Weekly Report, 1998). In 1990, at the peak of the last syphilis epidemic, the national rate of P&S syphilis reached 20.3 cases per 100,000 population, while the rate in the 16 southern states was 33.7 cases per 100,000 population-1.7 times higher. Syphilis in recent years is mostly concentrated in urban areas in most regions of the country.

Racial-ethnic minorities (especially African-Americans) in urban areas are more likely to live in areas of high poverty concentration (poverty concentration areas are defined as census tracts with a poverty rate of 20% or more) regardless of poverty status. Fifty-eight percent of urban Hispanic Americans in poverty and 64% of urban African-Americans in poverty live in areas of high poverty concentration (US Population Statistics, 1991).

A study done by Risser et al, in two inner-city communities in Houston, Texas aimed to develop a relevant, community-based prevention campaign for syphilis. The results showed that reported syphilis cases within the city of Houston were tightly clustered in approximately 15 of the city's 100 postal or ZIP code areas. These areas, which form a belt extending north to south just east of the city center, made up more than one-half (51.7 percent) of all P&S syphilis cases reported to the City Health Department during 1994 and 1995. Compared to the rest of Houston, these communities were found to have high rates of poverty, low levels of educational attainment, and large minority populations (Risser et al, 1997).

An ecological analysis done by Kilmarx et al, using the county as the unit of analysis, was performed to generate hypotheses about community-level determinants of syphilis rates. The methods include rank correlations. Mean annual incidence of primary-and secondary stage syphilis in a county was the dependent variable, and county sociodemographic characteristics (from census data) were the independent variables. The results from the multivariate regression model showed that sociodemographic characteristics accounted for 71% of the variation in syphilis rates among counties. With other factors accounted for, the most highly correlated characteristics were percentage non-Hispanic Black population, county location in the South, percentage of the population that was urban, percentage Hispanic population, and percentage of births to women younger than 20 years. In addition it was noted that identification and remediation of modifiable health determinants for which these factors are markers were needed to improve the health status of these populations or groups (Kilmarx et al, 1997).

Another research study (Nakashima et al, 1995) done on the "Epidemiology of syphilis in the United States, 1941-1993" examined the distribution and trends of syphilis based on biologic factors, sexual behaviors, availability of access to health care and sociocultural factors. The study design included surveillance data on cases of syphilis and congenital syphilis reported by state and city health departments to the Centers for Disease Control and Prevention. This data were analyzed to show distribution and trends by geographic location, racial and ethnic groups, gender, and age. The results showed that the rates of syphilis were highest for black Americans, while rates for white and other racial and ethnic groups were lower. The disease was more focused in the southern region and in urban areas outside the region. The study concluded that syphilis epidemiology is influenced by a complex combination of factors. In order to prevent and control syphilis effectively, public health practitioners must understand these factors and design programs and interventions that address the disease in the context of these factors.

The study (1995) done by Aral, on the social context of syphilis persistence showed that the combined effects of poverty, minority race-ethnicity, and geographic clustering apparently contribute to persisting syphilis morbidity, particularly in the southeastern United States (Aral, 1995).

A study (Laumann and Youm, 1998) on racial/ethnic group differences in the prevalence of sexually transmitted disease in the United States concluded that African Americans' higher infection rate for bacterial diseases can be explained by the patterns of sexual networks within and between different racial/ethnic groups. This study examined the network effects by constructing a contact matrix to reveal the network patterns

between different population subgroups. The entire sample was also divided into three groups according to their level of sexual activity: (1) "peripherals" are those who have had only one sexual partner in the past 12 months and who are therefore believed to be safe from infection; (2) "adjacents" are those who have had two or three sexual partners in the same period; and (3) "core group members" are those who have had at least four sexual partners in the same 12-month period and are therefore considered to be primarily responsible for the existence of sexually transmitted diseases in the population over time. The conclusion from this study indicated that relatively high sexual contacts between the African American core and its periphery facilitate the spread of infection overflow into the entire African American population (a so-called intraracial network effect). Secondly, sexually transmitted infections stay within the African American population because their partner choices are more segregated than other racial and ethnic groups (a so-called interracial network effect). The likelihood of African Americans having a sexually transmitted infection according to this study is 1.3 times greater than it is for whites because of this factor.

Research done by Rothenberg in 1983 (The geography of syphilis: A demonstration of epidemiologic diversity) used an algorithm to examine the distribution of syphilis in Upstate New York. The basic algorithm defined those census tracts containing 50% of cases as Core and those containing the next 30% as Adjacent and rest of the three metropolitan counties were called Peripheral. Areas outside the confines of the nine Upstate cities, but still within those counties, were termed Remainder. The results showed that socioeconomic status of those with syphilis from Core areas reflected

the general socioeconomic status distribution in the State. Movement outward form the Core to Remainder showed a profound change away from low socioeconomic status (from 22% in Core to 1% in Remainder) and toward high SES (from 16% in Core to 68% in Remainder). This suggested social diversity in the populations from which syphilis emanates. Risk and rates were calculated and the observation was that rates and relative risks were highest for black homo/bisexual men. The study also suggested that the order for risk factor attribution in this setting would be: black race, core area, male gender and homo/bisexual orientation (Rothenberg, 1983).

Previous theoretical and empirical findings have provided valuable insight into the transmission dynamics of STD (Blanchard et al, 1998). These findings have highlighted the importance of core groups in the spread of STDs within populations. The theory behind the concept of a core group is derived from the basic reproductive number in which the ecologic success of any infectious disease is defined as the average number of secondary infections arising from infected individuals in a susceptible population (Blanchard et al 1998). This thesis will use these theoretical findings as a basis for using geographic information system (GIS) as part of the methodology. Geographic information system (GIS) offers new opportunities to evaluate diseases that are characterized by geographically defined hyper endemic areas, or "cores". Spatial analyses have been used to define geographic "core areas" within which STD transmission rates are highest (Becker et al. 1998). Core areas are defined geographically

and are also characterized by poverty and poor health care access. These geographic core areas are hypothesized to contain a higher proportion of the core group members and thus provide a rational target for focusing control efforts.

Geographic Information System and Health

The area of GIS and Public Health has risen to prominence in the past two years with the recognition that health surveillance practices and health service allocations need to become more sensitive to the needs of people in targeted geographic areas (Yashoff et al, 1999). A geographical information system is a group of procedures that provide data input, storage and retrieval, mapping and spatial analysis for both spatial and attribute data to support the decision-making activities of the organization. Maguire (1991) defines three approaches to GIS: the map centered approach, the database approach, and the spatial analysis approach. This research project will emphasize the map-centered approach only. The map-centered approach defines "GIS" as a map processing or display systems. In map processing, each data set is represented as a map (also called a layer, theme or coverage). The database approach emphasizes the importance of the design and management of the database and the ability to answer locationally referenced spatial queries. The spatial approach focuses on analysis and modeling. Analyzing spatial data involves the determination of patterns of data associated with locations and the manipulation of location-related data to derive new information from existing data. Unwin (1983) describes this as being "concerned with spatial patterns defining the

locational relationships among points, lines, polygons, and surfaces and spatial processes that define the dynamic nature of these features in terms of distance, direction, and connectedness (page 57)."

The analysis of clusters of health problems involves the determination of patterns that indicate non-random occurrences and therefore require investigation of other relationships to understand the reasons for clustering, hence the need for GIS.

A GIS, however, can have multiple databases of different types of information, all linked to the same geographic references, so that an inventory of information about entities at a point, on a line, or in a polygon can be available for analysis. The analysis of data related to points include spatial query, geocoding and proximal analysis-dot –density mapping. Geocoding and dot-density mapping are utilized in this research. Geocoding is the assignment of location identifiers to spatial data for processing. It provides an automatic means to add geographic identifiers to attribute data at particular points. Dot-density mapping allows the automatic display of symbols such as dots at the points of features that have certain user-defined characteristics. Dot-density maps can be used to visually identify disease clusters such as syphilis and other sexually transmitted diseases.

There are several advantages of GIS technology for public health practice, planning and research. GIS technology improves the ability of practitioners, planners, and researchers to organize and link datasets (for example, by using geocode addresses or geographic boundaries). Geography provides a near-universal link for sorting and integrating records from multiple information sources into a more coherent whole (Richards et al, 1999). This ability to link datasets can help public health practitioners

plan more cost-effective interventions. For example, a research study by Becker et al in 1997 integrated GIS with clinical data systems to provide epidemiologic analysis for gonorrhea. GIS can maintain relevant demographic and health care statistics by geographic areas. Geographic areas commonly range from census tracts, to ZIP codes, to counties, and upwards to states and nations. GIS encourages the formation of data partnerships and data sharing at the community level, linking data for an individual with contextual information aggregated at a variety of geographic levels (for example, Census block group, Census tract, country, or state), and help community decision makers visualize and understand a public health problem. GIS allows for visualization of the data via maps for comparison between the geographic units, which assists in the interpretation as well as publication of health-related facts. GIS can document the locations of populations at risk based on their behavior and environment. People with similar demographic characteristic also have similar lifestyles (Emerson, 1994). GIS technology has identified lifestyle segmentation indexes, categorizing populations into behavioral and demographic groups. Communicable disease- patterns can be influenced by population behavior (Emerson, 1994). Thus, the geography of lifestyle segmentation indexes may provide public health managers with insights into populations at risk. Some diseases are environmentally related (e.g. methemoglobinemia in newborns from drinking water exposure). GIS technology has been used to evaluate the geographic pattern of gonorrhea in Baltimore, Maryland (Becker et al, 1997). Becker study showed

that mapping cases reported from STD clinics and non-STD clinic sector had similar geographic distribution, and that GIS can be effectively integrated with clinical data systems to provide epidemiologic analysis.

GIS is particularly suited for disease surveillance and monitoring. Some recent applications include vector-borne diseases (Glass et al., 1995; Beck et al., 1994; Richards, 1993) water borne diseases (Clarke et al. 1991), environmental health (Cuthe et al., 1992; Braddock, 1994; Barnes and Peck, 1994), modeling exposure to electromagnetic fields (Wartenberg et al., 1994), and quantifying lead hazards in a neighborhood (Wartenberg, 1992). Bishai et al (1998) applied GIS to analysis of TB transmission patterns in Baltimore. By mapping the home addresses of TB patients the study was able to assess the relationship between residence and disease. It concluded that recently transmitted TB occurred in high-risk neighborhoods where poverty, crime, drugs, homelessness, and alcoholism are prevalent. Through this research project using GIS we should be able to see on a map where the problem of syphilis transmission is occurring. In turn, this should provide the public health practitioners with the ability to provide quick responses to questions and concerns that might be raised in a community setting.

Chapter 2

METHODS

RESEARCH BACKGROUND

Many studies have observed that poverty; minority race-ethnicity, geographic location and sociocultural factors have influenced the distribution and trends of syphilis. However, it is important to determine the combined effect of all these factors in a targeted elimination of syphilis for Dallas County. The Sexually Transmitted Diseases unit of Dallas County has embarked on an elimination initiative but this does not include the combine effect of factors associated with syphilis transmission.

It is important to find out the implications of poverty that may be relevant to the transmission and elimination of syphilis. Poverty used in this research can be defined in economic terms. Economic poverty according to Dutch economist Aldi Hagenaars (Fisher, 1992) and colleague can fit into three broad categories:

1. Poverty is having less than an objectively defined, absolute minimum.
2. Poverty is having less than others in society.
3. Poverty is feeling that you do not have enough to get along.

All three categories have some relationship with income, which clearly plays a role in the determination of whether a household is poor. The first category corresponds to the

official U.S. poverty line, which defines the absolute minimum in terms of a basic food budget, multiplied by three to take care of other essential items such as housing and clothing (Fisher, 1992). This research will use the definition "Poverty is having less than an objectively defined, absolute minimum". For a family of four this minimum is an annual income of $17,184 (US Census Bureau, 1999).

RESEARCH HYPOTHESIS

Two hypotheses will examine the factors that influence the distribution and transmission trends of syphilis in Dallas County.

Hypothesis 1

Poverty is likely to cause increased number of cases of syphilis in a determined or specific geographic area. In areas of Dallas County where the median household income is lower, syphilis transmission will be greater. The United States syphilis epidemic currently affects some of the nation's most disadvantaged communities beset by poverty. Populations of southern states marked by primary and secondary syphilis rates that exceed Healthy People 2000 Objectives presents a socio-demographic profile which indicated that a greater proportion of the population in these states lives in poverty (Aral, 1995).

Hypothesis 2

The effects of poverty, minority race-ethnicity and geographic core areas are factors associated with the transmission of syphilis in Dallas County.

RESEARCH DESIGN

Materials and Methods

For the purpose of this research project, surveillance data on cases of syphilis (P&S) and congenital syphilis reported to The Dallas County Health Department were analyzed to show distribution and trends by geographic location, racial and ethnic groups, and gender. Reported cases (1998-1999) of primary and secondary syphilis (P&S) and congenital syphilis were obtained from STD clinics following the CDC reporting scheme (Dallas County Health, 1999). Cases were defined as persons tested on the basis of identification of *T. pallidum* by dark field microscopy from exudates from lesion or rash suspected of being syphilitic, or a positive serologic test. Cases of syphilis were treated according to the 1993 Centers for Disease Control (CDC) "STD Treatment Guidelines" (MMWR, 1989).

To perform geographic analysis of the data, the database obtained from the Dallas County Health STD unit was sorted and checked for duplicate records and completeness. Reported residential street address for each case was used to characterize the geographic distribution of syphilis. To accomplish this, addresses of cases were geocoded to digital base maps of census tracts for syphilis using Atlas GIS software and commercial digital base maps. The census tract for each case was then obtained by overlaying the database of residential addresses with census tract database. The software automatically links addresses from the syphilis database to census tract, zip code or other specified geographic unit if there is an exact address match. Addresses that could not be automatically geocoded (in the absence of an exact address match) were matched

interactively, using secondary search criterion. Eighty percent of cases were successfully matched with street addresses to produce the spatial database. Due to errors usually associated with spatial data such as typographical errors, incorrect spelling of street names, or new streets which are yet to be included in commercial digital spatial databases (see Openshaw, 1989 for a review), an 80% address match in geocoding is considered highly successful.

After cases were assigned to appropriate geographic units such as census tracts and zip codes, case per geographic unit were enumerated to assess where most cases occur. A geographic information system (GIS) which included data layers for street addresses, zip codes, 1990 census tracts and demographic data linked to each census tract and number of syphilis cases was then established. Syphilis frequency by spatial unit was then used to create thematic maps of syphilis for the study area (See Appendix C)

Data Analysis

Data analysis was conducted using Statistical Package for the Social Sciences (SPSS) for personal computers. Frequency statistics were computed according to ethnicity, sex, race and diagnosis. The 1990 census information was used with the zip code areas that were identified with syphilis cases. Correlations were run for household per capita income, median income, syphilis rate, syphilis, public assistance, percent Black, Hispanic and Whites.

Chapter 3

RESULTS

DESCRIPTIVE FINDINGS BASED ON GEOGRAPHIC INFORMATION SYSTEM

A total of 1204 cases of syphilis were processed by geographic information system. The resulting maps showed the syphilis cases by zip code region, census tract, street address and syphilis rate (see Appendix C – Syphilis cases by census tract, Dallas County, 1998-1999). The map showing syphilis cases by zip code region showed a high concentration (75-127 cases per 100,000) in the South Central zip codes (75216, 75232, 75241). Zip codes in the Southwest bordering the south central zip codes showed the second highest number of cases (50-75 per 100,000). The zip codes areas in the northern region of the map showed the lowest syphilis rates (1-10 per 100,000

The map showing syphilis rates by zip code (Appendix C – Syphilis rates by zip code) shows the central region (red region on map) as having the highest rates, with rates range from 59.00 to 340.00 per 100,000. Zip codes bordering these zip codes, the blue areas of the map had the second highest rates of syphilis. The range was 31.00 to 59.00 per 100,000. The green and yellow areas of the map showed zip codes with the lowest syphilis rates.

The syphilis rates calculated in this research for zip codes identified (see Appendix C – Syphilis rates by zip code) appear extremely high when compared to the 2.6 per 100,000 for United States in 1998 (CDC, 1998) and 2.2 (430 cases) per 100,000 reported by Texas Department of Health for the state of Texas in 1998 (TDH, 1998). This is not due to computation error. Similar rates have been reported by the Dallas County Health Department in 1999 (Reported Incidence of Infectious Conditions and Injuries by Geographic Area, 1998). The high rates of syphilis identified in these geographic areas make them prime targets for syphilis intervention and elimination programs.

Syphilis cases by census tract showed that the highest number of cases was found in the south central regions and west central region. The census tract with the lowest number of cases (1-3) was found mainly in the north, north central and northeast. These areas have a higher socioeconomic status when compared to the south and west central region. It was observed that the map showing cases by the census tract gave a better visual picture of number of cases found within a smaller area. The census tract map showed areas of cases of syphilis that were not apparent on the zip code map. This is significant when considering a syphilis elimination program. Those census tract with no shading (Appendix C) will be the least likely areas to target a syphilis intervention, since there are no clusters of cases.

The dot density map showing syphilis cases by street address, showed clusters of cases along a few of the streets in the south central region of the map. However the small scale of the map precluded displaying the street names to prevent overcrowding the map

and making it unreadable. Employing a large-scale map that permits display of clusters by street layer will facilitate a targeted approach to syphilis elimination in these areas.

STATISTICAL ANALYSIS

For the 1204 cases reported, ethnicity frequency showed 970 cases (80.6%) for non-Hispanic, 225 cases (18.7%) for Hispanic and 9 cases (0.7%) other. About 55% of the syphilis cases 661 were males and 543 (45.1%) were females. Blacks comprised 835 of the 1204 cases of syphilis (69.4%) blacks, 348 cases (28.9%) were whites, 7 cases (0.6%) were Asian/Pacific Islander, 2 cases (0.2%) were American Indian and 12 cases (1.0%) comprised other races (see Table 1).

The breakdown of syphilis diagnosis (see Table 2) were 710 (Primary 85, 7.1%), 720 (Secondary 147, 12.2%), 730 (Early, 661, 54.9%), 740 (Latent, 31, 2.6 %), 745 (Late Latent, 255, 21.2 %), 750 (Late syphilis with symptoms, 1, .1%) 760 (neurosyphilis, 23, 1.9%), 790 (congenital, 1, .1%)

Household median income, per capita income and percent of households receiving public assistance such as social security, food stamps etc. were used, as measures of poverty. Correlation between syphilis rates and the hypothesized variables are presented in Table 3.

When syphilis rate was correlated with household median income, per capita income and percent households receiving public assistance, very interesting patterns emerged. A significant, strong negative correlation was observed for median income (-.603), a somewhat weak correlation for per capita income and a strong positive

Demographic Characteristics of Persons Diagnosed with Syphilis, Dallas County, 1998-1999

Table 1

SEX

Code	Frequency	Percent	Valid Percent	Cumulative Percent
1	661	54.9	54.9	54.9
2	543	45.1	45.1	100
Total	1204	100	100	

1= Male, 2 = Female

ETHNICITY

Code	Frequency	Percent	Valid Percent	Cumulative Percent
1	225	18.7	18.7	18.7
2	970	80.6	80.6	99.3
9	9	0.7	0.7	100
Total	1204	100	100	

1= Hispanic, 2 = Non-Hispanic

RACE

Code	Frequency	Percent	Valid Percent	Cumulative Percent
1	2	0.2	0.2	0.2
2	7	0.6	0.6	0.7
3	835	69.4	69.4	70.1
4	348	28.9	28.9	99
8	2	0.2	0.2	99.2
9	10	0.8	0.8	100
Total	1204	100	100	

1= American Indian, 2 = Asian/Pacific Islander, 3 = Black, 4= White, 8&9 = Other

Diagnosis of Syphilis Cases, Dallas County, 1998-1999

Table 2

Type of Syphilis	Code	Frequency	Percent	Valid Percent	Cumulative Percent
Primary	710	85	7.1	7.1	7.1
Secondary	720	147	12.2	12.2	19.3
Early	730	661	54.9	54.9	74.2
Latent	740	31	2.6	2.6	76.7
Late Latent	745	255	21.2	21.2	97.9
Late syphilis w/symptoms	750	1	0.1	0.1	98
Neuro	760	23	1.9	1.9	99.9
Congenital	790	1	0.1	0.1	100
Total	1204	100	100		

Code represents type of syphilis.

Correlations between Syphilis & Hypothesized Variables, Dallas County, 1998 -1999

Table 3

	Per Capita Income	HH Median Income	PCTBLACK	PCTWHITE	PCTHISP
Per Capita Income					
Pearson Corr	1000	.720	-.533	.631	-.315
Sig. (2-tailed)		.000	.000	.000	.008
N	69	69	69	69	69
HH Median Income					
Pearson Corr	720**	1.000	-.552**	.697**	-.455
Sig. (2-tailed)	.000		.000	.000	.000
N		69	69	69	69
PCTBLACK					
Pearson Corr	-.533**	-.552**	1.000	-.906**	-.091
Sig. (2-tailed)	000	000		.000	.457
N	69	69	69	69	69
PCTWHITE					
Pearson Corr	.631**	.697**	-.906**	1.000	-.329**
Sig. (2-tailed)	.000	.000	.000		.006
N	69	69	69	69	69
PCTHISP					
Pearson Corr	-.315**	-.455**	-.091	-.329**	1.000
Sig. (2-tailed)	.000	.000	.457	.006	
N	69	69	69	69	69
PUBASIST					
Pearson Corr	-.583**	.687**	.724**	-.783	.236
Sig. (2-tailed)	.000	.000	.000	.000	.052
N	68	68	68	68	68
SYPRATE					
Pearson Corr	-.384**	-.603**	.494**	-.586**	.281*
Sig. (2-tailed)	.001	.000	.000	.000	.019
N	69	69	69	69	69
SYPHILIS					
Pearson Corr	-.311**	-.364**	.519**	-.542**	.137
Sig. (2-tailed)	.009	.002	.000	.000	.260
N	69	69	69	69	69

Correlations between Syphilis & Hypothesized Variables, Dallas County, 1998 – 1999

Table 3 Continued

	PUBASIST	SYPRATE	SYPHILIS
Per Capita Income			
Pearson Corr	-.583**	.-384**	-.311**
Sig. (2-tailed)	.000	.001	.009
N	68	69	69
HH Median Income			
Pearson Corr	-.687**	-.603**	-.364**
Sig. (2-tailed)	.000	.000	.002
N	68	69	69
PCTBLACK			
Pearson Corr	.724**	-.494**	-.519**
Sig. (2-tailed)	.000	.000	.000
N	68	69	69
PCTWHITE			
Pearson Corr	-.783**	-.586**	-.329**
Sig. (2-tailed)	.000	.000	.000
N	68	69	69
PCTHISP			
Pearson Corr	.236	.281*	.137
Sig. (2-tailed)	.052	.019	.260
N	68	69	69
PUBASIST			
Pearson Corr	1.000	.588**	.443
Sig. (2-tailed)		.000	.000
N	68	68	68
SYPRATE			
Pearson Corr	.588**	1.000	.433*
Sig. (2-tailed)	.000		.000
N	68	69	69
SYPHILIS			
Pearson Corr	.443**	.433**	1 .000
Sig. (2-tailed)	.000	.000	
N	68	69	69

correlation (-.588) for public assistance. Thus areas with relatively high incomes have low syphilis rates while low income and especially areas with a high number of households receiving public assistance incomes have high syphilis rates. There was a strong positive correlation between public assistance and syphilis rate (.588) and syphilis (.443) and is significant at 0.01 level. This means that areas that are receiving public assistance are likely to have cases of syphilis. Public assistance and percentage blacks (.724) and percentage Hispanics (.236) were positively correlated, while that with percentage white (-.783) was negatively correlated. This was significant at the 0.01 level. These observations are consistent with hypothesis I, poverty is likely to cause increased number of cases of syphilis in a determined or specific geographic area.

Syphilis rate was positively correlated with the percentage of blacks (.494) and Hispanics (.281), while negatively correlated with whites (-.586) and both were significant at less than 1%. Thus areas with high concentrations of Whites have significantly low rates of syphilis while areas with high black concentrations have significantly high rates. The weak, positive but significant correlation (.281) between percent Hispanic and syphilis rate suggests that while areas with high percentages of Hispanics have high syphilis rates, the relationship is not as strong as it is for Blacks. These observations are consistent with hypothesis II, that poverty, minority-race ethnicity and geographic core areas are factors associated with the transmission of syphilis.

Chapter 4

DISCUSSION AND STUDY IMPLICATIONS

DISCUSSION

Routinely collected syphilis data coupled with geographic information system can define the geographic patterns of syphilis in core areas. Maps showed the distribution patterns of syphilis according to zip code, census block groups, street and syphilis rates. These results showed- the presence of syphilis in certain geographic areas of Dallas County. The utilization of geographic information system was significant in identifying the "core areas" of syphilis. An identification of clusters of cases from a map can provide for a more targeted intervention of syphilis in these areas. As suggested in the CDC National Plan (October 1999) to eliminate syphilis, a geographic focus for syphilis elimination was identified in this project. This refers to a geographically defined setting. Since syphilis elimination activities can vary from one area to another, depending on the extent and distribution of the disease. Planning activities need to consider priorities and relevant local intervention strategies. The use of GIS in my research was appropriate, although previous studies have documented that syphilis is focally distributed, with higher rates in the southeastern United States, no study has showed the exact location (geography pattern) of syphilis cases in Dallas county.

The findings in this study showed that among persons diagnosed with syphilis in Dallas county, 69.4 % of the cases were blacks, 18.7 % were Hispanics and other percent were mainly whites. In addition males accounted for 54.9 % while females were 45.1%.

The findings from this study showed a strong positive correlation between public assistance and syphilis rate (.588) and syphilis (.443). Also when public assistance and percentage blacks (.724), percentage Hispanics (.236) and percentage white (-.783) were correlated. There were positive correlations for both blacks and Hispanics, while negative for whites. This suggests that this area is beset by poverty, which is consistent with hypothesis I. These findings are significant and are consistent with other studies and give an understanding of where and why syphilis transmission persists inspite of declining rates. These findings should be used to improve targeting syphilis elimination in these areas. Research findings have shown that syphilis is more prevalent among poor, undeserved populations in tightly focused areas of poverty. Laumann et al in 1998 reported that African Americans and Hispanics manifest higher rates of primary and secondary syphilis than other ethnic and racial groups in the United States.

The hypothesis on minority-race ethnicity and geographic core areas was confirmed. African Americans and Hispanics in these areas showed significantly higher rates of syphilis. Syphilis elimination efforts should be sensitive to the cultural needs of these groups. In addition effective targeting can be accomplished since core groups and areas were identified.

GIS for tracking STD's compared with traditional methods

The benefit of using GIS in tracking STD's is that it provides detailed maps, which gives a visual picture of where the problems spots are located. This method is a useful tool in helping to translate data into action. GIS can help provide quick response for public health decision-making. Maps can be constantly revised and generated to identify clusters of cases (STDs) that might arise from month to month. It might be challenging to get the attention of policy makers and community representatives if you have only tables of numbers or even graphs (Yasnoff & Sondik, 1999). GIS if used for STD's tracking can incorporate small area contextual data such as poverty levels in surrounding census block groups for analysis. To get the best outcome for STD's tracking with GIS, this method must be coupled with epidemiological and statistical analysis of the data.

Confidentiality issues will arise with the use of address matching. Gecoded data sets have the capability of linking a person's address with identifiable location, which might violate personal privacy. If the match was on a five-digit zip code, the confidentiality is preserved. Also if the address is matched to a census tract, the confidentiality is preserved. However, if the address is matched to a geographic base file with the specifics of individual streets and street segments, such as U.S. Census TIGER file, the confidentiality will not be preserved (Aldrich & Krautheim, 1995). There is need for the development of methods to assure confidentiality if GIS will be a method used to track STD's in the future.

Traditional public health methods for tracking STD's such as partner notification and screening might have disadvantages when compared to GIS. Screening remains an important component of syphilis control and prevention. However, when disease prevalence decreases, large-scale screening becomes less efficient (St. Louis, 1996). Therefore for a disease such as syphilis with declining rates, decisions must be made on areas to target for screening to determine transmission and persistence.

Partner notification cost is great and the results are low as suggested in some recent reports (Oxman, 1996). Efforts to try to notify sexual partners exposed to serious, sexually transmitted diseases remain an ethical mandate of health departments. GIS can complement these methods for a greater impact on prevention and elimination of STD's.

SPECIFIC RECOMMENDATIONS FOR SYPHILIS ELIMINATION IN THE COMMUNITY

Community Intervention Strategies

Findings from this research indicate that syphilis affects poor members of minority groups. Elimination efforts should point toward minority communities. These elimination efforts will reduce racial disparities in syphilis by providing better access to high quality, and culturally sensitive preventive care. To achieve elimination in the geographic defined areas of Dallas County, the following intervention strategies are recommended:

- Develop protocols for community assessment to identify local barriers, opportunities, and potential partners for prevention.

- Enhanced community health in south central and west central regions of Dallas County, which showed the highest number of cases. This can be done by engaging these communities and the Dallas Public Health department in a way that shares both control and responsibility.
- Use targeted community outreach programs, which includes appropriate methods for identifying sexual and social networks that may be involved in the spread of syphilis.
- Involve community-members in social and behavioral needs assessments and program planning, implementation and evaluations.
- To achieve syphilis elimination, citizens, including community leaders from south and west central regions of Dallas county, should be invited to guide and participate in the design and delivery of services, allowing for their ownership of interventions that improve the health status of their communities.
- Acknowledge and respond to the effects of racism, poverty and other relevant social issues on the persistence of syphilis in the United States.

Dallas County Health Department is presently involved in elimination efforts that include partner notification; condom distribution targeted to at-risk individuals in zip codes with high syphilis rates and is in the process of strengthening community collaboration with community-based organizations. These suggestions/recommendations should assist the Dallas County Health Department in launching an effective syphilis elimination program.

The impact of involving these affected communities in syphilis elimination in Dallas County can have far reaching implications. These communities such as south and west central Dallas affected by syphilis can:

- Facilitate more effective communication;
- Restore, build, and maintain trust
- Improve access to and utilization of services;
- Ensure the development of culturally competent interventions; and
- Mobilize participation to develop community capacity.

The public health implications of findings from this research are that areas of high syphilis transmission in Dallas County have been identified. In addition factors affecting syphilis has also been identified. Therefore this will allow for appropriate planning and intervention for syphilis elimination in these defined geographic areas. Policy development, which includes support from the affected communities to help address the syphilis problem, will also be done. Health Education programs and other initiatives can be used to inform and educate the affected communities to acquire the knowledge, change attitudes, and practice toward healthier communities that are syphilis free.

GENERAL RECOMMENDATIONS FOR SYPHILIS ELIMINATION

The general recommendations for syphilis elimination adopted by CDC in May 1998 should also be used in these affected communities. These strategies are:

1. Cross-Cutting Strategies
    a. Enhanced Surveillance
    b. Strengthened community involvement and partnerships
2. Intervention Strategies
    a. Rapid outbreak response
    b. Expanded clinical and laboratory services
    c. Enhanced health promotion

Race and ethnicity in the United States are markers that correlate with fundamental determinants of health status such as poverty, access to quality health care, health care seeking behavior, illicit drug use and living in communities with high prevalence of STDs.

The question that remains is "How does one deal with poverty, minority race-ethnicity in relation to the transmission and elimination of syphilis"? Prevention efforts must address these factors. There seems to be no 'magic bullet' for this situation' (Brandt, 1987). The Public Health Service maximized implementation of the biomedical model in the 1950s and eradicated syphilis from much of the United States, but failed to eliminate it entirely. Control strategies for syphilis elimination must include a tandem of strategies. An emerging body of evidence suggests that simply providing better access to care will not resolve the differences in health status between disadvantaged populations

and those with higher socioeconomic status. Unless improved health care access is coupled with social, educational, economic opportunities and behavioral interventions in the community resulting in improved socioeconomic status, economically disadvantaged populations, including racial and ethnic minorities, will continue to suffer excess morbidity from preventable infections (Toomey, 1993). It is imperative that as we seek to eliminate syphilis from defined geographic areas, we need to understand the social context of syphilis epidemiology in these communities. This will have important implications for future directions for programmatic interventions. These communities should receive resource allocations that reflect the distribution of syphilis morbidity. In addition, efforts must be made to concentrate the best, most effective clinical interventions, community-level social and behavioral approaches on preventing and eliminating syphilis. Finally, societal changes must be brought about to decrease the level of poverty and to improve the socioeconomic context of health in these communities.

LIMITATIONS OF THE STUDY

The age composition of the cases was not determined due to insufficient information. This factor should be considered in intervention strategies. To avoid bias in interpreting the maps produced it was necessary to critically evaluate the data quality and other confounding factors. The study was limited in its use of spatial statistical methods to interpret clusters seen on the map. The consequence of integrating data into a visually

easy to understand picture can be a setup for misunderstanding. One may infer causation from the map without adequately applying the principles and methods of epidemiology.

IMPLICATIONS FOR FURTHER STUDY

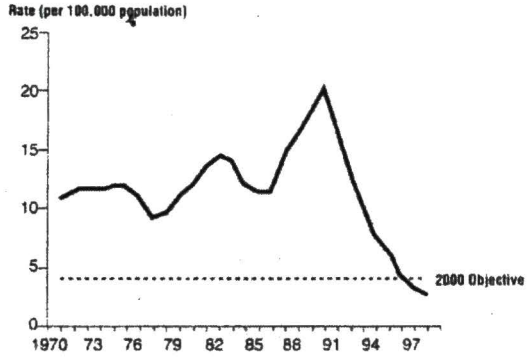
Finally, this research is far from complete. I believe that there is a need to geographically define areas of syphilis transmission into "core", "adjacent", "peripheral" and "remainder", and then calculate the rates of syphilis cases by importing the 1990 census data into the spreadsheet component of the GIS. This should allow for a more comprehensive analysis of syphilis transmission in these areas. Geographic analysis alone does not provide direct behavioral data-which is also a critical component of understanding STD epidemiology. More information is needed to explain the cluster patterns seen on the map. This research can be continued to include more spatial analysis. Maps of syphilis cases can be created weekly (monthly or quarterly) and then compared with previous weeks to identify unusual case cluster patterns. These will aid in continuity of quick-targeted approach to syphilis elimination efforts.

APPENDIX A

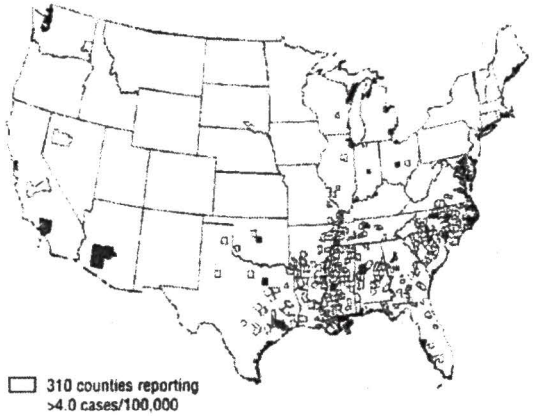
PRIMARY & SECONDARY SYPHILIS CASES IN US. 1970-1998

Primary & Secondary Syphilis Cases in US. 1970 - 1998

Primary and secondary syphilis–Reported rates: United States, 1970-1998 and the Healthy People year 2000 objective.



Primary and secondary syphilis–Counties with rates above the Healthy People year 2000 objective and counties reporting half of new cases: United States, 1998.



*Note: 1998 P&S rate for the U.S. is 2.6 per 100,000 (HP2000 target=4.0)
Source: CDC STD Surveillance System

* Credit

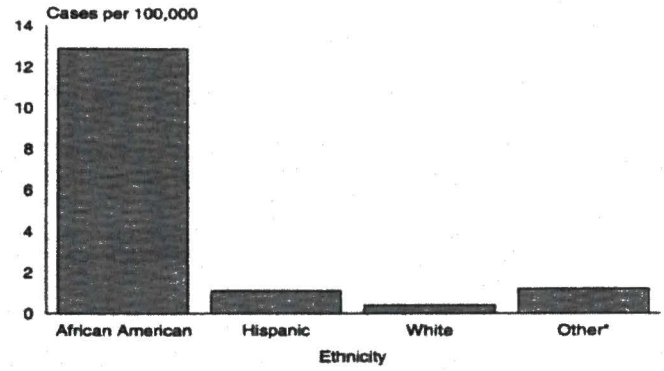
The National Plan to Eliminate Syphilis from the United States
Oct. 1999 Centers For Disease Control & Prevention

APPENDIX B

PRIMARY & SECONDARY SYPHILIS CASES IN TEXAS 1981-1998

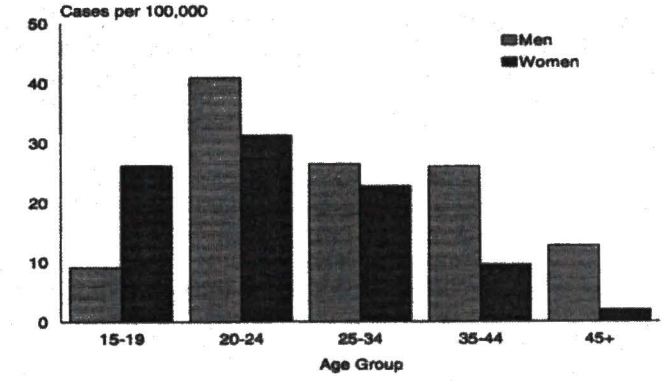
Primary & Secondary Syphilis Cases in Texas 1981 - 1998

Primary and Secondary Syphilis Case Rates by Ethnicity

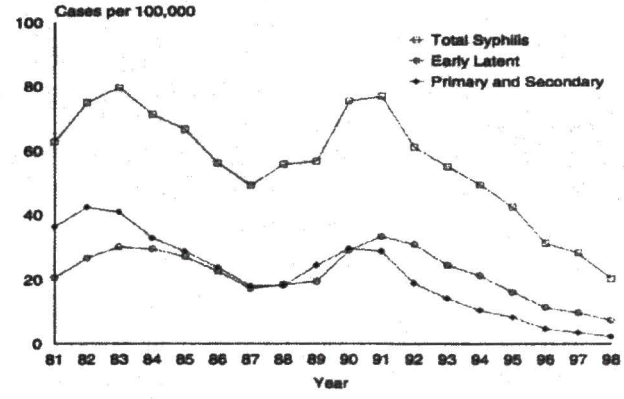


*Excludes cases of unspecified ethnicity

Primary and Secondary Syphilis Case Rates Among African Americans by Age Group and Sex

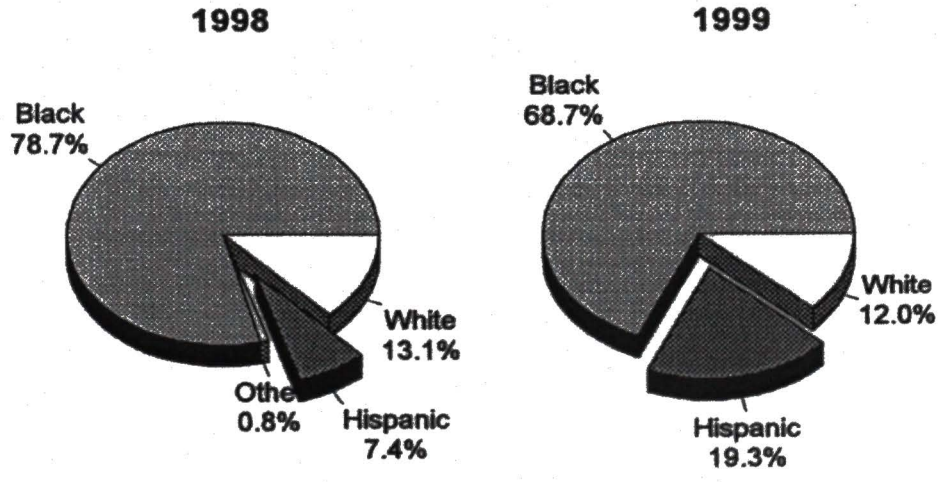


Syphilis Case Rates, 1981-1998



Reported Syphilis Cases				
	Jan-Dec 1999	Jan-Dec 1998	# Change	% Change
Primary	50	47	3	6.4%
Secondary	100	77	23	29.9%
Total P&S	150	124	26	21.0%
Early Latent	381	404	-23	-5.7%
Late Latent	151	200	-49	-24.5%
Congenital	3	23	-20	-87.0%
Total Syphilis	685	751	-66	-8.8%
Male Cases	364	410	-46	-11.2%
Female Cases	321	340	-19	-5.6%
Unknown	0	1	-1	-100%

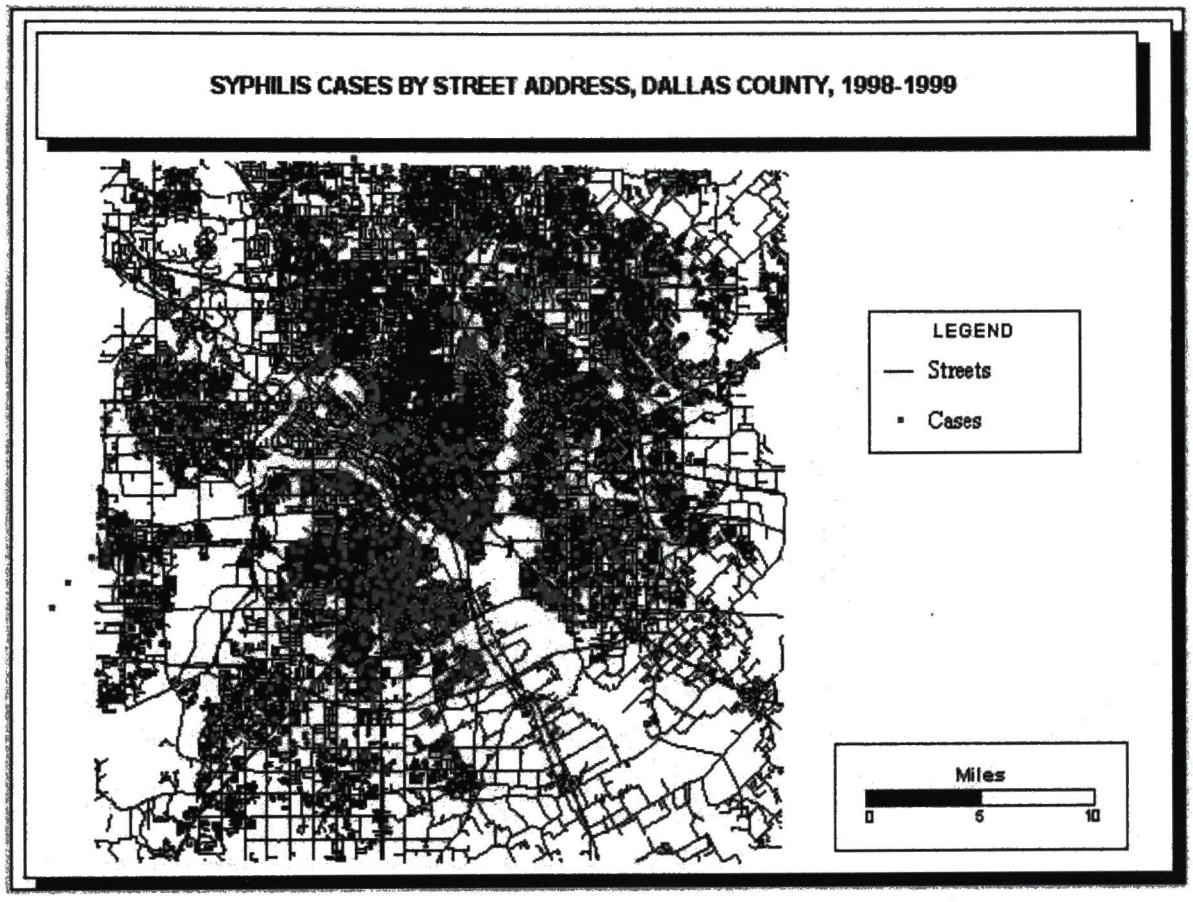
Comparison of syphilis morbidity in Dallas County for January to December 1998 and January to December 1999.

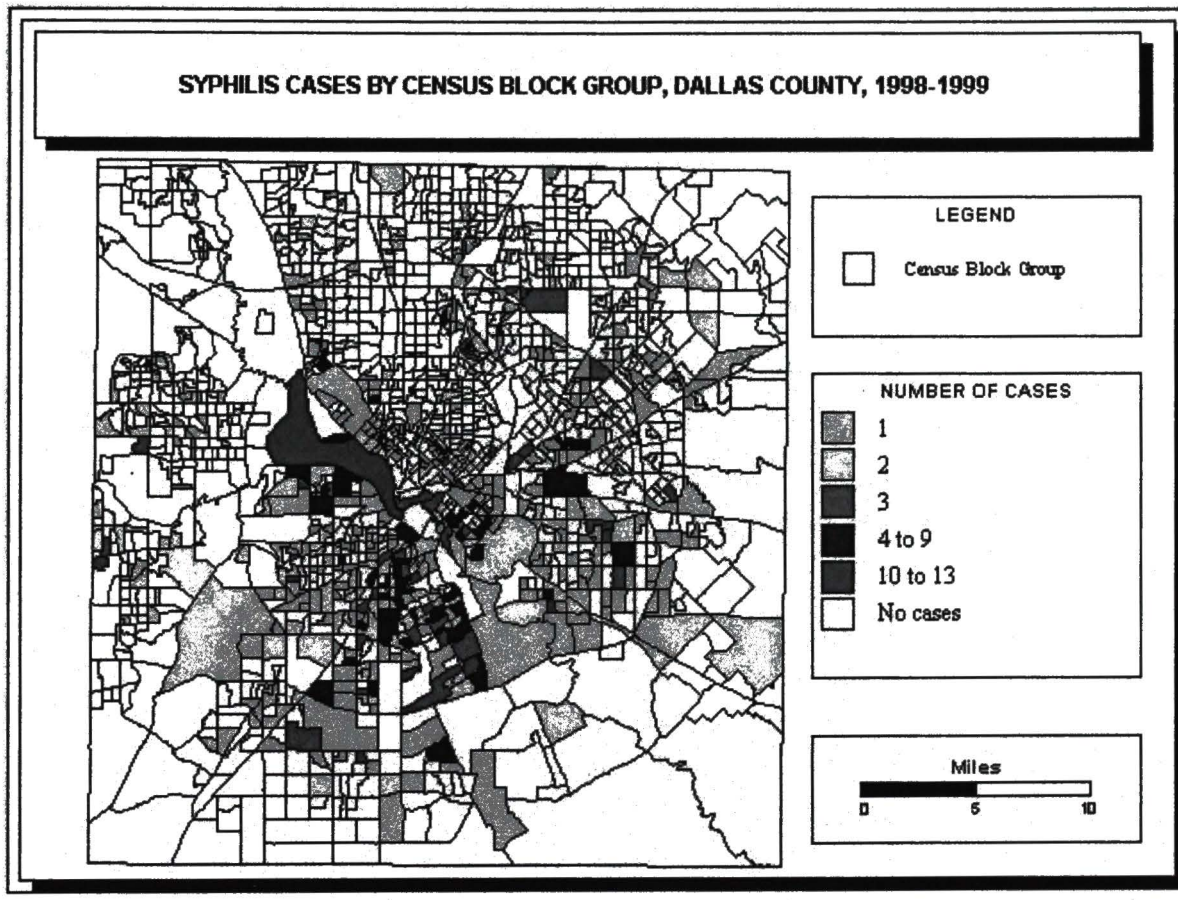


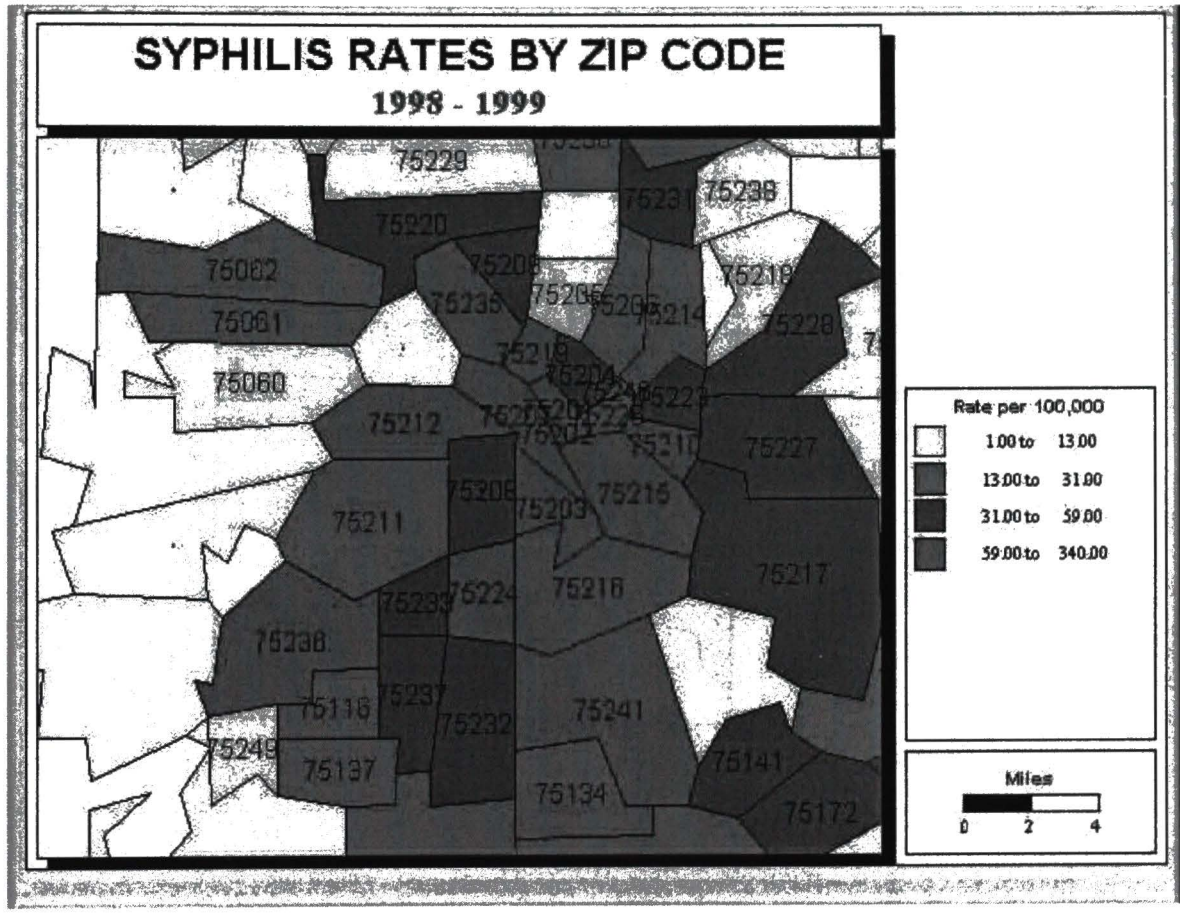
P&S syphilis cases by race in Dallas County for CY 1998 and CY1999.

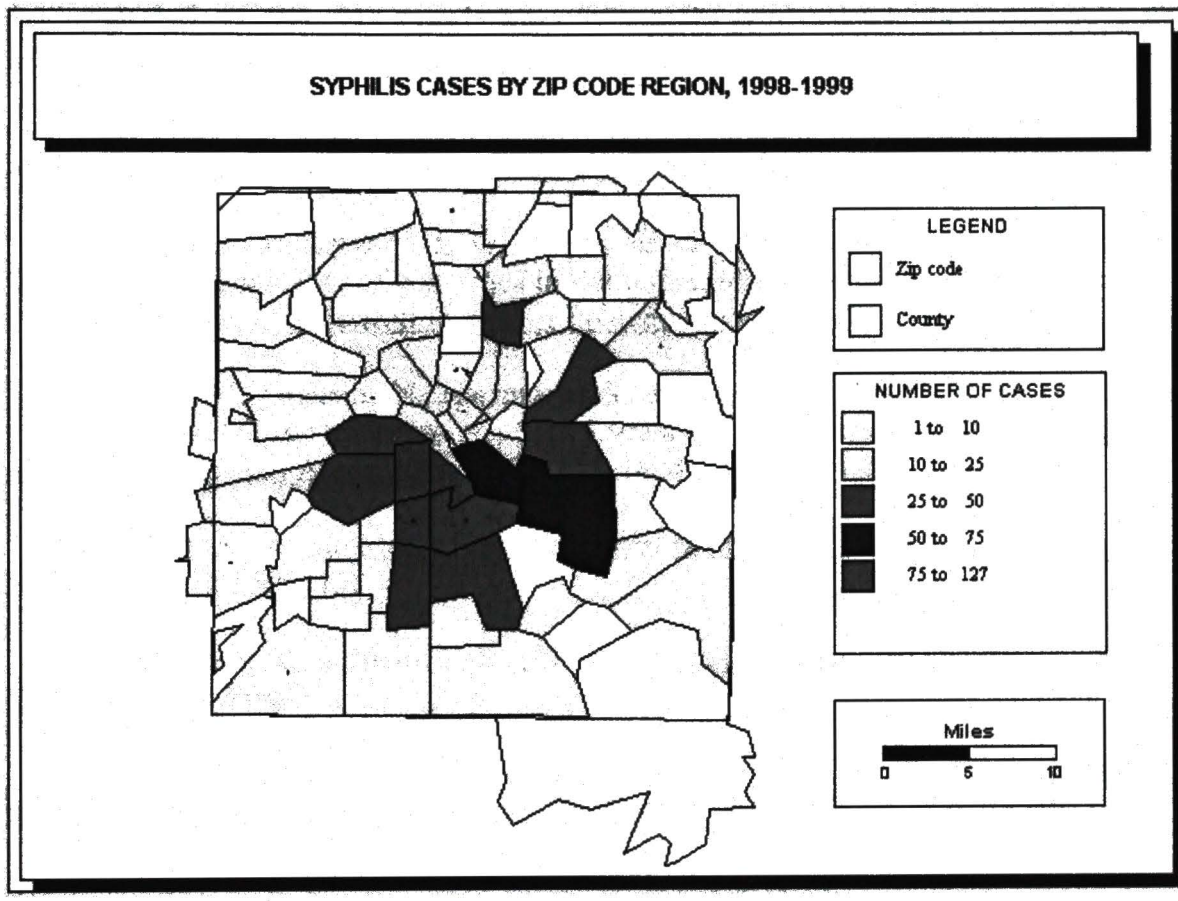
APPENDIX C

MAPS OF SYPHILIS CASES BY ZIP CODE, STREET AND CENSUS BLOCK


SYPHILIS CASES BY STREET ADDRESS, DALLAS COUNTY, 1998-1999
LEGEND
Streets
Cases
Miles
0
5
10


SYPHILIS CASES BY CENSUS BLOCK GROUP, DALLAS COUNTY, 1998-1999
LEGEND
Census Block Group
NUMBER OF CASES
1
2
3
4 to 9
10 to 13
No cases
Miles
0
5
10


SYPHILIS RATES BY ZIP CODE
1998 - 1999
75229
75220
75002
75081
75080
75212
75211
75238
75116
75249
75137
75232
75241
75134
75141
75172
75227
75217
75216
75203
75208
75224
75233
75237
Rate per 100,000
1.00 to 13.00
13.00 to 31.00
31.00 to 59.00
59.00 to 340.00
Miles
0
2
4


SYPHILIS CASES BY ZIP CODE REGION, 1998-1999
LEGEND
Zip code
County
NUMBER OF CASES
1 to 10
10 to 25
25 to 50
50 to 75
75 to 127
Miles
0
5
10

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