Excerpt from

Neighborhoods and Health:

Building Evidence for Local Policy

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Section 5

OAKLAND: TUBERCULOSIS INFECTION IN OAKLAND— AT-RISK POPULATIONS AND PREDICTING "HOT SPOTS"

PURPOSE AND APPROACH

This section summarizes the site-specific analysis prepared by the Urban Strategies Council in Oakland.[12] It focuses on the relationship between neighborhood conditions and tuberculosis infection.

Purpose

The Council conduced the work in close coordination with the Alameda County Public Health Department (PHD), which is designing community-based interventions to reduce the risk of certain diseases, including tuberculosis. New drugs discovered in the 1940s brought a tentative cure for this disease, and through 1984 its incidence declined nationally. There was striking reversal of the trend thereafter, however, associated with the AIDS epidemic, increasing immigration from abroad, and other factors (Cowie and Sharpe1998; Lillebaek et al. 2001; Talbot et al. 2001;). Tuberculosis today disproportionately affects minorities (Centers for Disease Control and Prevention1990), and there has been research and speculation about the spatial concentration of TB in distressed urban neighborhoods and poverty as a potential risk factor (Barr et al. 2001).

Council staff wanted to find out about the spatial pattern of tuberculosis in Oakland to help guide PHD in resource targeting and to better understand its association with variations in neighborhood conditions in the city (specifically, with minority and foreign-born populations, poverty, and overcrowded housing). The Council had initially hoped to conduct similar analyses with respect to sexually transmitted diseases (STDs) and AIDS in Oakland as well, but PHD data administrators so far have been unwilling to release the relevant data owing to confidentiality concerns (an issue discussed further later in this section).

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[12] The study is fully documented in an as yet unpublished report of the Urban Strategies Council, *Tuberculosis Infection in Oakland, CA 1997-2001: At-Risk Populations and Predicting "Hot Spots" An Analysis Method Combining Kernel Density Estimation Mapping with Regression,* 2002.

Data sources and approach

The Tuberculosis Control Unit of PHD provided the Council with data on reported cases of tuberculosis in Alameda County from 1997 through 2001. Only the 456 cases with residences in the city of Oakland were used in the analysis. Data on the independent variables were from the 2000 census.

As with most of our other site-specific analyses, Council staff ran correlation analysis (bivariate and multivariate) to test their hypotheses, and mapped spatial patterns as well. However, they used an innovative approach to do so. Normally in this type of work, analyses are run on data sets with values for all variables provided for comparatively small administrative or data collection areas (e.g., census tracts or block groups). In this case, the staff applied data originally provided (using addresses to pinpoint locations for the 456 tuberculosis cases and the centroids of Oakland's 337 block groups for the census variables) to then estimate values of all variables for all of the cells in a much more finely grained grid (69,181 square cells with 150-foot sides).

The methodology for any variable involves interpolating between the point locations for the values given in the original data to estimate values for cells in between. The work was done using the "single kernel density routine" in the CrimeStat II software package (originally developed for identifying "hot spots" of criminal activity).[13] The approach leads to a more accurate understanding of spatial patterns. The traditional approach yields *chloropleth* maps like that shown in figure 5.1, with colors or tones of indicating uniform intensities in each census tract. The new approach yields *isopleth* maps with contour intervals, as in figure 5.2, that can show more accurately how patterns of intensity change *within* tracts without the constraints of arbitrary political or planning boundaries.

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[13] The method of interpolation was the normal distribution. The choice of bandwidth was that of the fixed interval and their fixed interval was 0.253 square miles, the mean nearest neighbor distance between block group centroids in Oakland.

Figure 5.1: Tuberculosis Cases by Census Tracts in Alameda County 1997-2000, (Chloropleth Map)

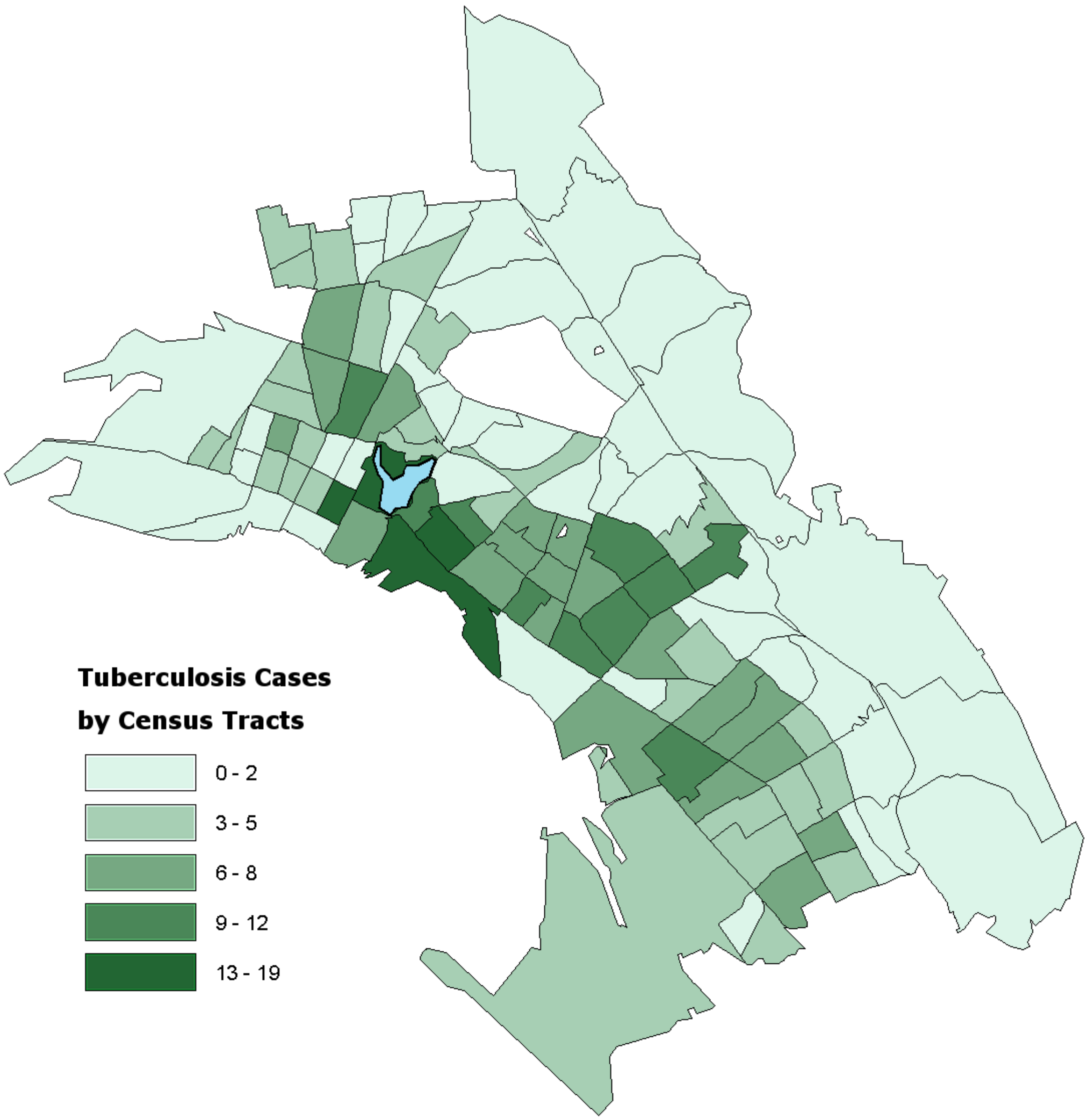
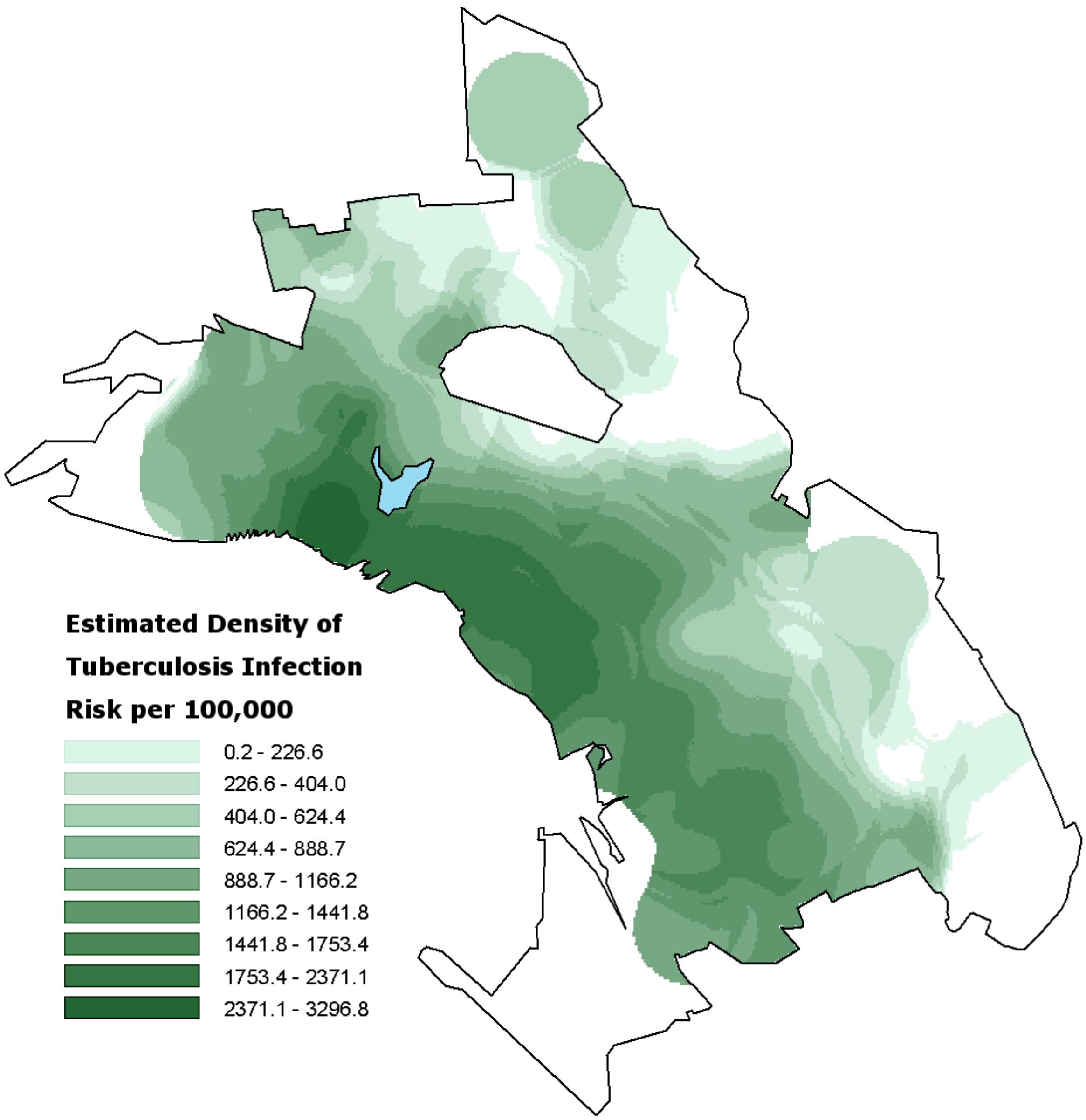


Figure 5.2: Estimated Density of Tuberculosis Infection Risk per 100,000 population in Alameda County 1997-2000, (Isopleth Map)



FINDINGS AND IMPLICATIONS

Hypotheses and main findings

The work focused on the Urban Strategies Council's analysis of three main hypotheses concerning relationship between neighborhood conditions and tuberculosis:

1. *That incidence rates of tuberculosis are positively correlated with the percentage nonwhite population and the percentage foreign-born population.*
2. *That incidence rates of tuberculosis are positively correlated with the percentage of people in poverty.*
3. *That, controlling for the demographic and economic relationships above, incidence rates of tuberculosis are positively correlated with the number of occupants per room in housing units.*

Accordingly, the analyses measured the relationship between the rate of incidence of tuberculosis (cases per 100,000 population including both males and females, or TB100K), the dependent variable, and six independent variables:

- Males as percentage of population (PER_MALE)
- Percentage of population in poverty (PER_POV)
- Nonwhites as percentage of population (PER_NONW)
- Immigrants as percentage of population (PER_IMM)
- Occupants per room (C_CROWD)
- Percentage of population over 65 years of age (PER_65)

The bivariate analysis showed that the relationships between all of the predictors and tuberculosis were positive except for age. The strongest of these was the immigrant percentage, +0.64. Coefficients from the multivariate analysis are given in table 5.1. Summary statistics are as follows:

R Square and Adjusted R Square = 0.481
Std. Error of the Estimate 719.081
Durbin-Watson = 1.625
Change Statistics:

- R Square Change = 0.481
- F Change = 9165.634
- Significance of F Change = .000

Table 5.1
Coefficients: Multi-variate Analyses

	Unstandarized coefficients			Standardized coefficients	95% confidence interval -B	
	B		Standard error	Beta	Lower bound	Upper bound
(Constant)	3127.74	*	60.17		3,009.80	3,245.68
Per_male	2966.19	*	137.67	(0.083)	(3,236.03)	(2,696.35)
Logit of Per_pov	189.35	*	4.57	0.223	180.39	198.31
Logit of Per_nonw	37.80	*	3.27	0.062	31.38	44.21
Logit of Per_imm	635.07	*	5.91	0.505	623.48	646.65
Square of c_crowd	277.15	*	23.86	0.081	230.38	323.92
Square of per_65	7725.61	*	323.76	0.193	17,091.04	18,360.18

* Significant at the .0001 level

In sum, 48.1 percent of the variance in tuberculosis in Oakland can be explained by the six variables, indicating that this is a strong model. Immigration is the single most important variable that predicts tuberculosis, followed by poverty.

Mapping analysis

As noted in section 8, Oakland is not like the prototypical big city with high-poverty neighborhoods all clustered around the city center—its spatial pattern is much more complicated. The staff began the analysis by preparing a series of chloropleth maps of the incidence of tuberculosis (like the map at the tract level in figure 5.1) for various types of administrative areas: City Council Districts, PHD Health Team Areas, and ZIP Codes, in addition to census tracts. Because of the way the areas are configured, each map suggested that different areas of the city were experiencing the highest incidences of tuberculosis. Also, it was apparent that the areas were generally too large to provide useful information to guide intervention and prevention efforts.

The map in figure 5.2 is an isopleth map of the estimated density of the risk of tuberculosis infection. It shows spatial patterns in a more precise way, indicating variations within the larger geographies noted above. Therefore, it should support operational planning and management more effectively. While earlier maps highlighted fewer and larger geographies, the risk map shows that downtown, Chinatown, and neighboring areas reaching into West Oakland, as well as the Lower San Antonio and Fruitvale areas southeast of Lake Merritt, are where prevention efforts should be targeted. This analysis shows that combining regression analysis with kernel density estimation can be a powerful way to analyze disease infection geographically.

Implications and community process

As of this writing, the uses of the Urban Strategies Council's report are not fully planned, but some steps have been taken and others agreed to. The central staff of PHD have been briefed on the results of the analysis and its significance. A considerable amount of PHD work in the community occurs through Neighborhood Health Teams, and there is agreement that meetings will be held to discuss the findings with the Teams. These discussions will highlight the opportunities for action with the Teams that work in the neighborhoods identified in the analysis as having a high risk for tuberculosis. Also, a community-driven Health Working Group has recently been established in the Lower San Antonio area. The Urban Strategies Council has been working closely with residents and leaders in that area for years, as a part of the Annie E. Casey Foundation's Making Connections initiative and in other ways. Accordingly, special efforts will be made to brief the new Health Working Group on the report and its implications.