

## Changes in the spatial distribution of syphilis

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### Objective

To study the spatial distribution of syphilis at the county level for specific states and nationally and to determine how this might have changed over time in order to improve disease surveillance.

### Introduction

Public health officials and epidemiologists have been attempting to eradicate syphilis for decades, but national incidence rates are again on the rise. It has been suggested that the syphilis epidemic in the United States is a 'rare example of unforced, endogenous oscillations in disease incidence, with an 8–11-year period that is predicted by the natural dynamics of syphilis infection, to which there is partially protective immunity' (1). While the time series of aggregate case counts seems to support this claim, between 1990 and 2010, there seems to have been a significant change in the spatial distribution of the syphilis epidemic. It is unclear if this change can also be attributed to 'endogenous' factors or whether it is due to exogenous factors such as behavioral changes (e.g., the widespread use of the internet for anonymous sexual encounters). For example, it is pointed out that levels of syphilis in 1989 were abnormally high in counties in North Carolina (NC) immediately adjacent to highways (2). The hypothesis was that this may be due to truck drivers and prostitution and/or the emerging cocaine market (1). Our results indicate that syphilis distribution in NC has changed since 1989, diffusing away from highway counties (see Fig. 1).

### Methods

Using CDC data for syphilis, we construct county-level syphilis distribution maps for NC and Florida and time series (1990–2010) of spatial distributions of syphilis for Florida. Additionally, for comparison, we construct county-level (from 2004 to 2010) and state-level (from 1995 to 2010) syphilis distribution time series.

### Results

Maps of cases (per 100,000) in NC show that the disease has spread into rural counties and is no longer concentrated along the highway (see Fig. 1). In Florida, along with the overall decrease in syphilis incidence, the distribution of cases becomes more concentrated from 1990 to 1998. When, in 1999, syphilis



Fig. 1. Syphilis incidence rates in 2010 are no longer concentrated along I95.

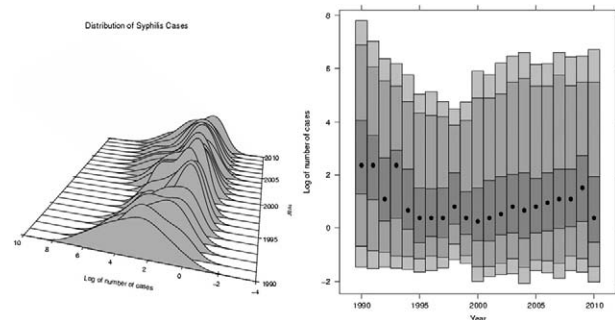


Fig. 2. Distribution of syphilis incidence in Florida from 1990 to 2010.

incidence rates begin to increase again, the distribution again widens and spreads to more rural communities (see Fig. 2).

The time series of national state-level syphilis distribution indicates an increase in the number of states at the extremes of the distribution (i.e., with very high or very low case counts). However, at the same time, the national county-level distribution remains stationary. This indicates that counties with high case counts are clustering in states with high case counts and similarly counties with low case counts are clustering in states with low case counts.

### Conclusions

The county-level spatial distribution of syphilis has changed significantly since 1990 and in ways that may depend on exogenous factors. Higher prevalence of syphilis in states seems more due to an increase in syphilis in counties that earlier had a low incidence of the disease. County-level syphilis data present a rather nuanced picture of how syphilis incidence has changed over the years and may form the basis for effective interventions.

### Keywords

Spatial distributions; time-series analysis; syphilis

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### References

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