

A Space-time Permutation Scan Statistic and its Application on Early Detection of Tuberculosis Outbreaks in Iran (2006-2011)

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Abstract

Exact locations of patients, primary residences at the time of diagnoses are routinely collected as part of the TB surveillance program to ability clusters and detect disease outbreaks Tuberculosis early is important in order to decrease morbidity and mortality through timely implementation of disease prevention and control measures. It has been shown for syndromic surveillance data that when exact geographic coordinates of individual patients are used, higher detection rates and accuracy are achieved compared to when data are aggregated into administrative regions such as zip codes and census tracts. Many national, state, and local health departments are launching disease surveillance systems with daily analyses of hospital emergency department visits, ambulance dispatch calls, or pharmacy sales for which population-at-risk information is inaccessible or inappropriate.

Keywords: Space-time permutation scan statistic; Clusters detection; Mapping; TB disease

Methods and Findings

We apply a variation of space-time permutation scan statistic to the TB data in which a patient location is either represented by its exact longitude and latitude or by the centroid of its census tract and propose a prospective space-time permutation scan statistic for the early detection of Tuberculosis and anymore disease outbreaks that uses only case numbers, with no need for population-at-risk data. It makes minimal assumptions about the time, geographical location, or size of the outbreak and it adjusts for natural purely spatial and purely temporal variation. We show that the detection sensitivity and timeliness of the method generally improve when exact locations are used to identify both simulated and real TB outbreaks; however,

better performance measures were attained under simulated cases as compared to actual outbreaks. The new method was evaluated using daily analyses of hospital emergency department visits in New York City. Four of the five strongest signals were likely local precursors to citywide outbreaks due to rotavirus, nor virus, and influenza. The number of false signals was at most modest.

Results and Conclusion

In the context of a disease such as TB with chronic characteristics, we denote an outbreak is detected early if it is identified within months (less than a year) from the start of the outbreak. If such results hold up over longer study times and in other locations, the space-time permutation scan statistic will be an important tool for local and national health departments that are setting up early disease detection surveillance systems.

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