A Spatial Cluster Analysis of Massachusetts Infectious Disease Mortality, 2002-2011

Overview

Current trends in infectious disease mortality are not commonly examined in Massachusetts and there may be long term and cyclical patterns that are not being detected. The objective of this analysis is to examine spatial trends in infectious disease mortality in Massachusetts over a ten-year period from 2002-2011 with a particular focus on HIV and Hepatitis C (HCV) in order to better inform public health resource allocation.

Background

HIV and Hepatitis C (HCV) are two sexually transmitted infections of great public health concern in Massachusetts. Deaths in HCV are increasing annually and while HIV in the United States is on a decline; it exists as a chronic condition for many people. Mortality rates of both of these conditions and their trends over time are not readily available.

Death certificates in Massachusetts allow for 1 underlying cause and 15 contributing causes of death. While most analysis conducted on mortality trends are conducted using only underlying cause, patterns may exist that are more visible using contributing causes as well. (Melamed & Sorvillo, 2009). This analysis makes use of both underlying and contributing cause of death to detect these patterns in HIV and HCV.

Hot spot cluster analysis is a useful method for determining where geographic clusters of disease exist (Getis & Ord, 1992). These analyses have been conducted to find clusters of diseases and mortality occurrences in a variety of settings (Burr, Jerrett, Burnett, & Anderson, 2002; Gundogdu, 2010). Stopka et al. have developed a few step process to detect valid clusters of diseases (Stopka, Kowalczyk, Grabiel, & Genchiy, 2014). This method was used to determine geographic patterns of infectious disease mortality in this analysis.

Methods

All deaths from 2002-2011 that featured HIV or HCV as an underlying or contributing cause of death was selected from the Massachusetts Death Certificate Database with census tract ID numbers. Census tract shapefiles were included in a statistically significant cluster (p<.05) and 440 census tracts were included in a statistically significant cluster (p<.05) and 440 census tracts were included.

Results

After performing hot spot cluster analysis following the 5-step Geoprocessing approach, there were 893 cases of HIV and 894 cases of HCV that were included in a statistically significant cluster (p<.05). HIV census tracts were more statistically significant for clustering than HCV tracts. The Getis-Ord Gi* test calculates a Z-score, while blue denotes statistically significant coldspots.

Discussion and Conclusions

The results of this analysis find several significant mortality hotspots and coldspots for Hepatitis C and HIV which can help inform resource allocation in the state. This approach is novel in that it makes use of both underlying and contributing causes of death to investigate clusters of mortality in an empirical way.

There exist several limitations of this study. Many practitioners receive little training in death certificate completion which can bias results. Additionally, when using multiple cause data, the decedent’s death may not have had to do with the infectious disease in question. For example, if someone who was HIV positive died in a car accident, they would still not be included in the analysis despite HIV not having contributed to their death.

As a result of these data using death data rather than incident data, the locations where people are currently dying of these conditions may differ from where current transmission is taking place. These clusters may be more indicative of people living with chronic HIV and HCV which is still of use to better target long-term treatment for these conditions.

Further research should take into account other socio-demographic characteristics such as race, income, gender, etc. as these factors may be correlated with high or low mortality rates for these conditions and may also exhibit geographic clustering. Hotspot cluster analysis when performed empirically presents a valuable resource for public health practitioners in identifying locations of high priority. Death certificate data used with a multiple cause approach also presents a valuable opportunity for characterizing trends in infectious disease.

References


Tufts University

Public Affairs and Published Affairs