

Identifying and Modeling Spatial Patterns of Heat-Related Illness in New York City

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OBJECTIVE

This paper describes the spatial pattern of New York City (NYC) heat-related emergency medical services (EMS) ambulance dispatches and emergency department visits (ED) and explores how this information can be used in planning for and response to heat-related health events.

BACKGROUND

During heat waves the New York City Department of Health and the Office of Emergency Management utilize the Heat Emergency Plan that includes responses such as the opening of cooling centers and targeted messaging to vulnerable populations. In 2006, New York City experienced a severe 10-day heat wave during which 46 people died of heat stroke. However, the number of people who died of other causes due to the heat and the overall burden of heat-related illness was not known. Subsequently, a systematic retrospective analysis was conducted to determine how vital statistics and syndromic surveillance data might best be used in planning for future heat events. Temporal analyses were improved by the inclusion of meteorological variables in a model of expected visits allowing for the identification of heat waves with particularly severe health response. The analyses also suggested that severe heat waves might be identified early. It was hypothesized that spatial signals may identify areas of the city that have persistent increases in illness during these events.

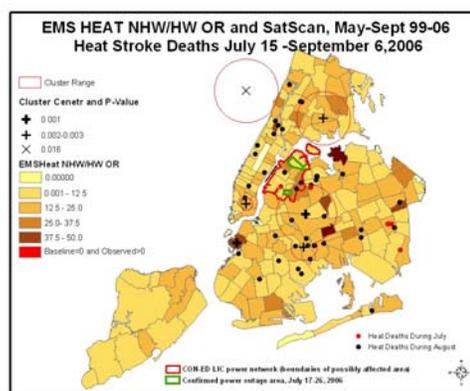
METHODS

Daily EMS ambulance dispatch call data are transmitted electronically from the NYC Fire Department to DOHMH and include all medical 911 calls coded into 52 broad call-types. ED data come from 48 of 62 NYC hospitals covering 90% of total ED visits and including chief complaints. We use data from May to September, 1999-2006 in this study. Daily temperature data were obtained from the National Weather Services. We defined heat waves as any period that has maximum daily temperature $\geq 90^\circ\text{F}$ for three days or more. The Heat Call Odds were calculated use heat/total calls rate on heat wave days divided by the rate on the non-heat wave days. Spatial analysis is performed using SatScan with all non-heat wave days as baseline control and all heat wave days as cases. We developed two models using Poisson regression (one controlling for temporal

trends only, the other controlling for temporal trends and meteorologic factors).

RESULTS

The graph below shows the spatial pattern of NYC EMS heat calls. The odds of heat calls are higher at low income neighborhood (South Bronx and East Brooklyn) and the top tourist attractions (Brooklyn Bridge and Statue of Liberty). It doesn't suggest strong association between the distribution of heat stroke death and the EMS heat calls. The significant spatial SatScan clusters locate at the high heat call odds areas.



A simulation of daily analyses was then conducted retrospectively for all heat waves 1999-2006. For 2006, no signal occurred during the first heat wave (7/2-7/4). Signals occurred on the all three days of the second heat wave (7/16-7/19). During the third and most severe heat wave (7/27-8/5), 8 signals were generated and first one was on 7/29/07. The signals correspond with identified areas.

CONCLUSIONS

Certain areas of the city have persistent increases in heat-related illnesses during heat waves. ED signals tend to be near vulnerable populations while EMS signals also occur around tourist sites. We can investigate these spatial signals further to determine factors influencing response to heat including built environment and land use characteristics and demographic and behavioral variables. The identified areas can be targeted for intervention and the interventions can be evaluated using these methods.

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