Emerging Health Threats Journal 2011, 4:s126. doi: 10.3134/ehtj.10.126

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ABSTRACT

Spatial cluster detection in schools using school catchment information

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Objective
To improve cluster detection of influenza-like illness within New York City (NYC) public schools using school health and absenteeism data by characterizing the degree to which schools interact.

Introduction
The H1N1 outbreak in the spring of 2009 in NYC originated in a school in Queens before spreading to others nearby.[1] Active surveillance established epidemiological links between students at the school and new cases at other schools through household connections. Such findings suggest that spatial cluster detection methods should be useful for identifying new influenza outbreaks in school-aged children.

As school-to-school transmission should occur between those with high levels of interaction, existing cluster detection methods can be improved by accurately characterizing these links. We establish a prospective surveillance system that detects outbreaks in NYC schools using a flexible spatial scan statistic (FlexScan), with clusters identified on a network constructed from student interactions.[2]

Methods
We use three data sets provided by the New York City Department of Education: 2008–2009 enrollment data, NYC Automated Student Health Record data, and absentee data that reports the number of students absent per school class on a given day.

The school interaction network can be constructed in several ways including quantifying the association between school catchment areas or enumerating the potential interactions between schools. For the former, two schools with students distributed equivalently across geographic areas would be perfectly associated ($\tau = 1$), whereas schools with no overlap would have none ($\tau = 0$). For the latter, the number of potential interactions between two schools could be summed across geographic areas. One example of this would be the number of household connections between the two schools. For our analyses, we used the number of potential interactions between the two schools by student home zip code. The resulting interaction matrix is then converted to a network by choosing a cutoff value.

The data streams included absenteeism as a percentage of enrollment and total influenza-like illness visits. For each day, the observed values were compared with a baseline period constructed from the previously reported 15 school days. We input the interaction matrix, XY coordinates, and observed/expected data into FlexScan. We ran prospective daily analyses for the school year 2008–2009, excluding high school students. Details of daily clusters were recorded. Here we focus on the 2009 H1N1 outbreak period.

Results
The results for the Spring 2009 H1N1 outbreak show two periods of significant activity: 28 April 2009–30 April 2009 and 13 May 2009–1 June 2009. The former period reported nine clusters (five in Queens, two in Brooklyn, and two in the Bronx). The latter has a total of 42 clusters (23 in Queens, 9 in Brooklyn, 9 in the Bronx, and 1 in Staten Island). During this period, the activity began in Queens, which reported at least one cluster per day, and towards late May spread to Brooklyn and the Bronx. By early June, activity slows and clusters are generally smaller. The clusters themselves differed greatly from those identified using only the circular scan method (Figure 1).

Conclusions
The method presented here improves upon existing approaches by quantifying interactions between students at different schools and is thereby more consistent with the actual process of disease diffusion. Clusters are identified when these interacting schools have increased absenteeism or school nurse visits. The analysis has a couple of limitations: (1) a school must have reported on a given day to be included in that particular analysis and (2) the data only includes public schools. However, with increased coverage both in terms of number of schools and regularity of reporting the system could alleviate these problems.

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2011, **4**:s126

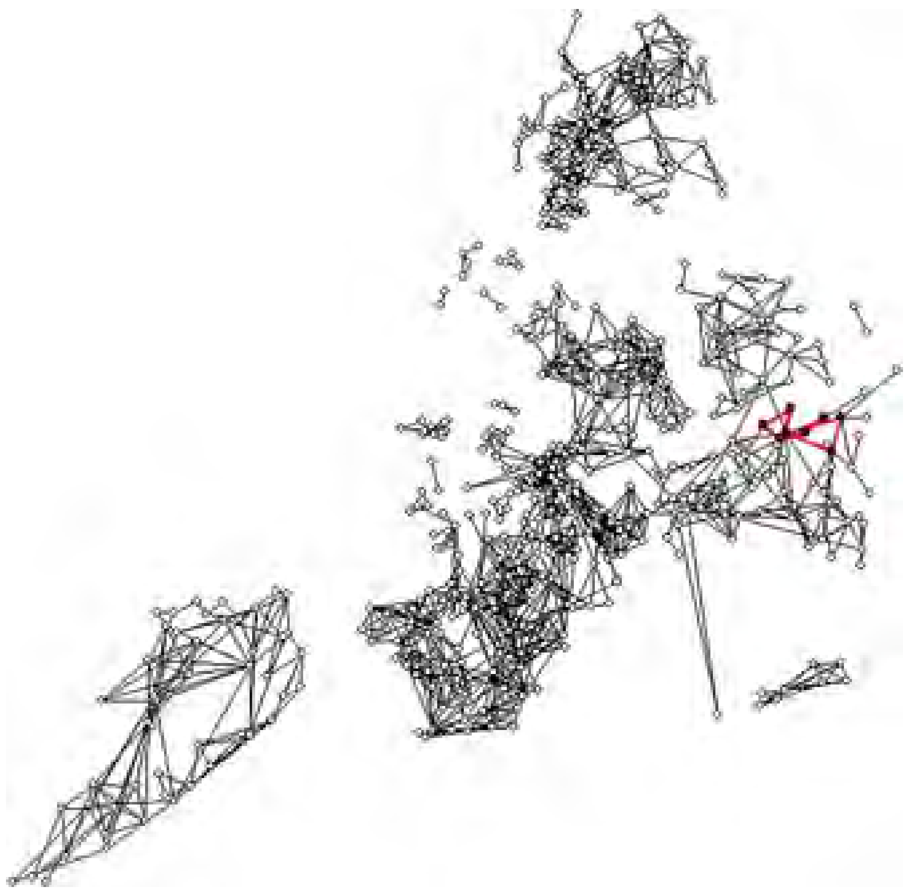

Figure 1 An example of network of elementary schools with connections defined by potential interactions between school catchments, highlighting an active cluster in Queens (4 May 2009).

Acknowledgements

This paper was presented as a poster at the 2010 International Society for Disease Surveillance Conference, held in Park City, UT, USA on 1–2 December 2010.

References

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