Spatio-Temporal Visualizations as Interface: Constructing Geographic Animations of Disease Surveillance Data in a Syndromic Surveillance System

Karl Soetebier, M.P.W., Erin L. Murray, M.S.P.H., Alex Cowell, C. & G.

Georgia Division of Public Health

OBJECTIVE

This paper describes an approach to the visualization of disease surveillance data through the use of animation techniques applied to datasets with both temporal and geospatial components.

BACKGROUND

As the Georgia Division of Public Health began constructing a systems interface for its syndromic surveillance (SS) program, the nature and intended use of these data inspired new approaches to interface design. With the temporal and spatial components of these data serving as fundamental determinants within common aberration detection methods (e.g., Early Aberration Reporting System [EARS], SaTScan™) [1,2], it became apparent that an interface technique that could present a synthesis of the two might better facilitate the visualization, interpretation and analysis of these data.

Typical presentations of data spatially oriented at the zip code level use a color gradient applied to a zip code polygon to represent the differences in magnitude of events within a given region across a particular time span [1,3,4]. Typical presentations of temporally oriented data use time series graphs and tabular formats. Visualizations that present both aspects of spatially and temporally rich datasets within a single visualization are noticeably absent.

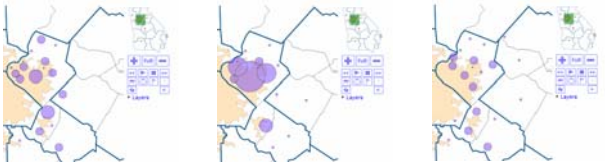
METHODS

Our review of the use of zip code color gradients found that often there is a lack of sufficient contrast between shaded regions to fully decipher the magnitude of a grouping of spatially related events [3,4]. Hence, we employed a different visualization technique in our State Electronic Notifiable Disease Surveillance System (SendSS) SS module. The SendSS SS module draws a semi-transparent circle around the geographic center of a zip code and then adjusts the radius of that circle to represent the magnitude of events reported.

Similarly, our review of spatial visualizations found a limited capacity for the temporal representation beyond a static range of days. When advanced capabilities were present, significant load-times hindered analysis. In the SendSS SS module, we provide the ability to quickly step through these data forward and backward in time. This can be done manually 1 day at a time or it can be "played" like a movie over the entire time span queried, creating a dynamic animation of event data. Additional temporal features include the ability to control the speed of the animation and the ability to set a variable moving "window" of time to be represented (e.g., 5 days of events overlaid on each other.)

RESULTS

These key features, when taken together, produce a unique visual experience that allows the observation of event data through a variable time progression, while simultaneously observing the spatial structure of these data. This synthesis has demonstrated its effectiveness in highlighting statistically significant events by providing the user with distinct visual queues when an anomaly is present. The figures below illustrate an actual detection, seen on Day 2, of one such statistically significant event temporally confirmed by EARS.



Day 1 Day 2 Day 3

CONCLUSIONS

In the end, this visual interface technique provides yet another entry point into the analysis and interpretation of SS data. While more formal studies might be executed to fully evaluate the effectiveness of this technique compared with other methods, initial anecdotal evidence in favor of it has been strong. Because of the technique's dynamic quality, high interactivity, and its tight integration into the framework of the system, users find that it facilitates the aberration detection process while it compliments the resultant investigative processes that occur once an aberration has been detected.

Additional work is needed to fully assess its value in the context of an actual event of public health significance. Further refinements to the modeling process, including the incorporation of SaTScan™, are under development.

REFERENCES

[1] Hutwagner L, et al, The bioterrorism preparedness response early aberration reporting system (EARS). J Urban Health 2003;80(2 Suppl 1):i89-96.

[2] Kulldorff M and Information Management Services, Inc. SaTScan™ v6.1: Software for the spatial and space-time scan statistics. http://www.satscan.org/, 2006.

[3] Bradley CA, et al, BioSense: Implementation of a national early event detection and situational awareness system. MMWR 2005;54(suppl):11-19.

[4] DoD, ESSENCE: Electronic surveillance system for the early notification of community-based epidemics. http://www.geis.fhp.osd.mil/geis/surveillanceactivities/essence/essence.asp

Further Information: Karl Soetebier, ksoetebier@dhr.state.ga.us