Too Many Signals? Frequency and Quantitative Descriptions of Detected Events

Christopher McClean, M.S., Jeffrey Johnson, M.P.H., Brit Colanter, M.P.H.
Michele Ginsberg, M.D.
San Diego County Health & Human Services Agency, Community Epidemiology Division

OBJECTIVE

This paper describes the frequency, various "shapes" and magnitudes of data anomalies, and varying ways actual public health events may present themselves in syndromic data.

BACKGROUND

San Diego County Public Health has been conducting syndromic surveillance for the past few years. Currently, the system has become largely automated and processes and analyzes data from a variety of disparate sources including hospital emergency departments, 911 call centers, prehospital transports, and over-the-counter drug sales. What has remained constant since the system's initial conceptualization is the local opinion that the data should be analyzed and interpreted in a variety of ways, in anticipation for the variety of contexts in which events that are of public health interest may unfold. Relatively small increases in volume that are sustained over time will likely be detected by methods designed to detect "small process shifts", and include the CUSUM and EWMA methods [1]. Larger increases in volume that are not sustained over time will likely be detected by other employed methods (P-Chart in the event of a non-proportional increase in volume, U-Chart in the event of a proportional increase in volume). A retrospective analysis was conducted on historical data from various data sources to determine the frequency of signals and detected events as well as the context within which the alert occurred (i.e., the "shape" of the data). Findings regarding several actual public health events will also be discussed.

METHODS

Using an iterative approach, historical syndromic data were analyzed with the various methods commonly used in the field of syndromic surveillance. A 30-day baseline is used, resulting in the first outputted analysis occurring 31 days into each historical dataset, continuing through to the most recent day. Each time a flagged event occurred, specific information was appended to a "Historic Flags Table." Recorded information included event date, chief complaint category, method(s) that generated the signal, count, baseline mean and standard deviation. Information on detected events were then quantified and subsequently reviewed to assess the frequency by which certain syndrome categories or statistical methods signaled. Likewise, the frequency by which signals occurred, across data sources for the same period, were also quantified.

RESULTS

While syndrome categories were largely standardized across data sets (e.g., GI, Fever, Respiratory), for selected time periods, various data sources experienced more numerous signals than others. Two of the data sets that produced relatively infrequent signals were prehospital ambulance transports (.52 signals/day) and 911 calls (.45 signal/day). When the data were evaluated by syndromic group, it was determined that some were more stable than others. Some of the groupings that are evaluated daily are not "traditional" syndromic categories (e.g., Hazardous Materials Exposure & COPD), and tend to have fairly small numbers. These categories produced more signals than more traditional syndrome categories like GI. When the statistical signals were evaluated by type of method, it was determined that the methods designed to detect small process shifts produced signals more frequently than the methods designed to detect large deviations from baseline mean. However, the latter methods were superior in picking up short-term increases that were attributed to natural events (the 2003 Firestorm) as well as media-related events ("Clinton Effect" and an increase in chest pain immediately following the London terrorist attack).

CONCLUSIONS

Several conclusions can be drawn from this exercise. Primarily, the analysis of historical syndromic data provides valuable insights into the characterization of signal frequency. Furthermore, signal frequency varies widely by data set and syndrome category, and, since data used to assign cases into syndrome groups varies by data set, differences likely exist based upon the interaction of the two. Several well-publicized events of public health significance were represented in various data sets. These events manifested themselves as rapid increases and subsequent decreases in syndromic counts, and illustrate the advantage of incorporating a variety of methods designed to detect various types of data anomalies.

REFERENCES

[1] Montgomery, DC, Introduction to Statistical Quality Control, 4th Edition. John Wiley & Sons, Inc., New York, 2001.