Identifying Categories of Over-the-counter Products with Superior Outbreak Detection Performance

William R. Hogan M.D., Garrick L. Wallstrom, Ph.D., Ran Li, M.S.

The RODS Laboratory, Department of Biomedical Informatics, University of Pittsburgh

OBJECTIVE

To develop a procedure that identifies product categories with superior outbreak detection performance.

BACKGROUND

A significant research topic in biosurveillance is how to group individual events—such as single emergency department (ED) visits and sales of over-the-counter healthcare (OTC) products—into counts of "similar" events. For OTC products, the goal is to find categories of individual products that have superior outbreak detection performance relative to categories that biosurveillance systems currently monitor.

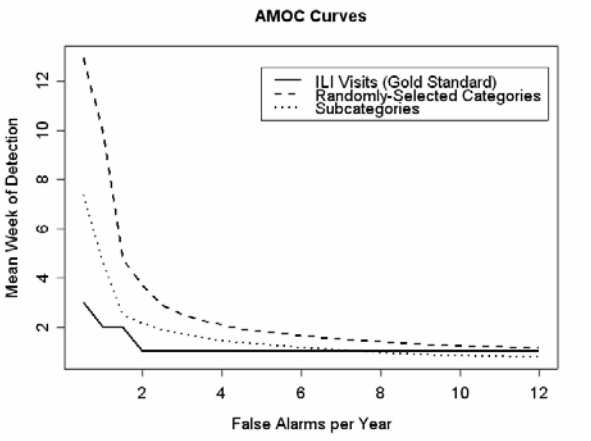
We have described a method to identify OTC categories that correlate more highly with disease activity than existing categories.[1] However, it is an open question whether a category that correlates more highly—or according to some other model has a higher 'association'—with disease activity than an existing category necessarily has superior detection performance. Here, we evaluate whether a linear regression procedure that clusters OTC products based on how well they 'explain' ED visits for influenza-like illness (ILI) can find categories with superior outbreak-detection performance for influenza.

METHODS

We developed a linear regression procedure that aggregates products into clusters based on how well they 'explain' outbreak data and applied it to OTC product sales data and ED ILI visit data in southwestern PA. The dataset of OTC sales was from AC Nielsen Corp., covered the years 2002-2004, had 90% market share, and had weekly sales counts for 3647 unique products, many of which we would not expect *a priori* to correlate with influenza (e.g., hydrocortisone ointments). The influenza dataset was ED diagnoses from 7 EDs covering the same time period. We generated 4000 random product categories of 100 products each and applied the procedure to them to find the subset that best "explained" ILI visits. We measured the correlation (with ILI visits) of both the randomly-selected *parent* category and the *child* category output by the procedure. We used an 8-week moving average Cusum algorithm to measure false alarm rates and detection timeliness. We plotted the mean false-alarm rate vs. mean timeliness for parent vs. child categories vs. ILI visits. We measured the percentage of products in each National Retail Data Monitor category that had a high retention rate (i.e., appears in child category 75% or more of time).

RESULTS

The mean correlation of the randomly selected parent categories with ILI visits was 0.558. Similarly, the correlation of the child categories identified by the procedure was 0.674, an average increase of 0.117 (95% CI: 0.113-0.120). The mean timeliness of detection of child categories was lower than that of their parents at every false-alarm rate (Figure). Overall, a greater percentage (61.8%) of adult thermometers had high retention rates than any other category.



CONCLUSIONS

Our linear regression procedure found product categories with superior outbreak-detection performance relative to their randomly-generated parents. Thus, we have shown our procedure capable of pulling 'signal' out of 'noise'. However, it could—when applied to new problems—fail to find categories with superior performance if it cannot extract sufficient signal. The study was somewhat biased towards a positive result because we used the same outbreak for generating categories and measuring detection performance. Overall, thermometer sales contributed most to timely detection of influenza with few false alarms, consistent with unpublished case studies of the same influenza outbreak.[2]

ACKNOWLEDGEMENTS

NLM grant 5 R21 LM008278-01, AC Nielsen Corp.

REFERENCES

1. Li R, Wallstrom GL, Hogan WR. A multivariate procedure for identifying correlations between diagnoses and over-the-counter products from historical datasets. *AMIA Annu Symp Proc.* 2005:450-454.

2. Rizzo SL, Grigoryan VV, Wallstrom GL, Hogan WR, Wagner MM. *Using Case Studies to Evaluate Syndromic Surveillance, RODS Technical Report*: RODS Laboratory; 2005.