Approaches to Prediction Models for Poison Control Center-Based Syndromic Surveillance for Foodborne Illness

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Objective

To construct and validate a prediction algorithm that detects early increases in laboratory reports of enteric illnesses on the basis of calls to a poison control center reporting suspected foodborne illnesses.

Background

Poison control centers (PCCs) provide a new source of real-time data that could enhance public health surveillance systems for foodborne disease outbreaks (FBDOs) by enabling timelier alerts. However, their current data collection systems were developed for acute clinical care, and may lack information necessary for syndromic surveillance. In addition, the health department database was designed to capture data on notifiable illnesses reported to the state and the CDC; cases are tracked using the illness report date. The Arizona Poison and Drug Information Center (APDIC) and the Pima County Health Department (PCHD) are currently evaluating the utility of APDIC's data collection and triage system to provide early detection of FBDOs in Pima County [1,2].

Methods

Data on calls to APDIC with reported foodborne illnesses and PCHD enteric illness reports were obtained for July 1, 2002 – June 30, 2007. Prediction algorithms were constructed using the first two and a half years of data ("training data set"), and validated in the remaining two and a half years ("test data set"). Multiple outcomes were assessed including raw counts, five and seven day moving averages, and exponentially weighted moving averages. Models using these outcomes were compared when unadjusted and adjusted for seasonal variations. Because the gold standard did not include data on FBDOs, i.e., cases that were epidemiologically linked to a common food source, increases in laboratory reports of enteric illnesses were used as a proxy measure for FBDOs. Temporal association was evaluated using APDIC calls on the date that they were received and on the caller reported symptom onset date if known and PCHD reports of enteric illness cases on the reported symptom onset date. Possible lag effects in the relationship between calls and cases were also explored. Random imputation methods were used to estimate symptom onset dates for PCHD cases in which the symptom onset date was unknown. Sensitivity analyses were conducted to evaluate model performance.

Results

Seventy-five percent of cases were reported to PCHD within approximately 3 weeks of symptom onset. In contrast, 62% of callers contacted APDIC within 24 hours of symptom onset. Forty-five percent of the PCHD "training" data set and 25% of the "test data set" was missing symptom onset dates, which necessitated imputing missing onset dates. The imputed time series structure changed for each estimate, generating alarms that varied in number, timing, and intensity. Therefore, models were constructed and tested using only those cases with known symptom onset dates. Figure 1 provides an example of the "gold standard" with two different randomly selected estimates.

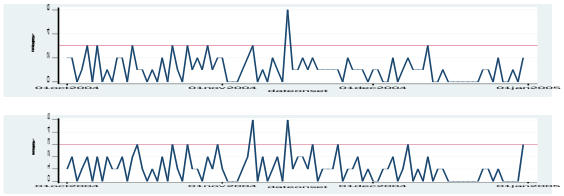

Figure 1 – Plots of PCHD cases using random imputation methods.

Adjusted moving average models performed the best; however, at low threshold levels, which would be considered unacceptable by health departments.

Conclusions

APDIC calls provide an earlier indication of suspected foodborne illnesses than the current PCHD reporting system; however, data quality and the inability to use actual foodborne outbreak data hindered our ability to fully evaluate the usefulness of a PCC as a means of enhancing county foodborne illness surveillance system.

Given that PCCs provide an earlier indication of suspected foodborne illnesses than current health department capacity, it would be worthwhile to fully implement a PCC foodborne illness detection algorithm.

References

[1] Derby M, et a,. Poison control center-based syndromic surveillance for foodborne illness. MMWR 2005;54(Suppl):35-40.

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