Linking North Carolina's emergency department and ambulance records for disease surveillance

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Introduction

The objective of this project was to develop and evaluate a probabilistic algorithm to link records from the North Carolina Emergency Department Database (NCEDD) and the Pre-hospital Medical Information System (PreMIS), two new unique electronic resources that are available in North Carolina.

NCEDD includes information on emergency department visits that is collected as part of the North Carolina Hospital Emergency Surveillance System (NCHESS) and is aggregated, enhanced and maintained as part of the North Carolina Disease Event Tracking and Epidemiologic Collection Tool (NC DETECT). The PreMIS system collects information on ambulance runs, such as descriptions of initial condition of the patient and the geographic location at the time-of-contact with the state's Emergency Medical Services (EMS). This information, although not collected in NCHESS, may be useful for public health surveillance activities, and therefore limited PreMIS data elements are maintained by NC DETECT.

Consequently, linkage of PreMIS and NCEDD records within NC DETECT may improve the state's ability to use electronic data for event detection (such as syndromic surveillance), injury prevention, public health monitoring, and planning for medical care after a natural disaster or terrorist event. In addition, linkage of PreMIS and NCEDD records may provide a way to complement quality control of data coding and/or detect problems in data reporting by analyzing the information that is derived from these two independent reporting systems. However, there are no common patient identifiers that could be used to link PreMIS and NCEDD records within NC DETECT.

We posited that probabilistic linkages of PreMIS and NCEDD records could be achieved using the following information: the patient's sex, date of birth, destination facility, and time of arrival at the emergency department. Non-unique matches would be addressed via a second stage procedure that employed shrinking caliper width on the time of arrival. We explored this hypothesis via a demonstration project that involved NCEDD and PreMIS records for a single day.

Methods

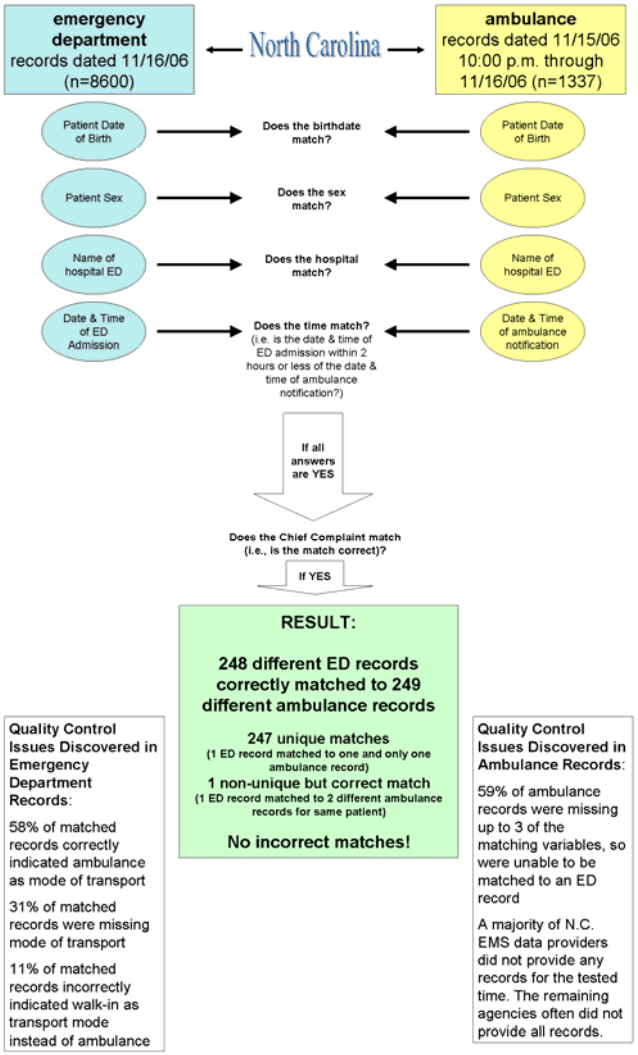
Sampling 1 day of data: We identified a "typical" day for this linkage project by selecting a date on which the number of PreMIS records was close to the median number of PreMIS records logged each day. On this basis, we chose November 16, 2006 as the date on which to match PreMIS and ED records. We selected all 8600 ED visit records occurring on that date, and all 1337 unique PreMIS records dated 11/15/06 at 10:00 p.m. through 11/16/06. Matching variables were then re-coded identically in both datasets, in preparation for running the matching algorithm.

Experimenting with Matching the Records:
We initially matched on four fields: ED Facility, date and time (considered a match if date and time of ambulance notification from PreMIS occurred within two hours prior to ED admission date and time), sex, and DOB.

We experimented with different time matching windows, finally deciding that 2 hours captures the most unique matches. Using this method, all of the matches were correct.

Manual review of the text descriptions of chief complaint from both data sources provided support for the conclusion that the matches were valid.

Results



Discussion

We demonstrated that linkages between NCEDD and PreMIS can be established via this probabilistic algorithm with a high level of validity. All linkages established in our pilot phase of this project appear to be valid and all but one were unique. However, a large number of cases in the NCEDD system that were reported to have been transported to the ED by ambulance were not linked to a PreMIS record. This appears to be due to incomplete reporting in PreMIS.

We demonstrated that linkage of PreMIS and NCEDD records provides a way to complement quality control activities across both systems. For example, via the activities of this demonstration project, we identified duplicate PreMIS records within NC DETECT, a problem not previously recognized. We also found, as mentioned above, that all of the ED cases in NCEDD that were recorded as having been transported by ambulance to hospitals in several large counties could not be linked to any PreMIS records. This was not due to a failure of our linkage algorithm; rather, the demonstration linkage identified that there was a systematic problem in data reporting to PreMIS in these counties on the date the linkage algorithm was tested. We estimated that approximately 90 of the 300 active data providers to PreMIS contributed ambulance run data for the 26-hour period. Lastly, linkages were also hampered by hospitals failing to report to NCHESS on mode-of-transport to the ED in the records in NCEDD.

This demonstration project suggests that valid linkages between PreMIS and NCEDD can be achieved via a probabilistic algorithm; however, in order for this linkage procedure to be effectively utilized for public health surveillance purposes, a higher level of completeness in reporting to PreMIS must be obtained.

Ongoing work is addressing data quality and completeness in both data sources and application of the matching algorithm to data from a single county where both ED and EMS data are complete.

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