Timeliness Study of Radiology and Microbiology Reports in A Healthcare System for Biosurveillance

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We developed a framework to measure the timeliness of two data types—radiology and microbiology reports—for detection of diseases such as inhalational anthrax (IA) in a healthcare system. We measured the timeliness of a data type as the delay between patient registration in an emergency department (ED) and receipt of data type by a biosurveillance system. We also determined the lower and upper bounds of median delay time (LMDT and UMDT) for the two data types to be available for detection of a single IA case. Based on the data received from the University of Pittsburgh Medical Center (UPMC) Health System, the LMDT time was 1.5 days and UMDT time was 6.4 days. The study provides a range of delay time for detection of a single IA case within a healthcare system, and it may benefit outbreak planning and outbreak model simulation.

Introduction

In addition to chief complaints and ICD-9 codes[1] commonly used in biosurveillance, radiology reports and microbiology test results can facilitate more precise diagnosis of specific diseases such as inhalational anthrax (IA). Clinical findings like a wide mediastinum in a radiology report and gram positive rods in a microbiology report present a suspected IA case. It is of interest for bio-surveillance to measure how early/late the two data types can be available for disease diagnosis. Our previous study[2] estimated the amount of time to detect an anthrax outbreak based on literature review and a simulation model. In this study, we presented a framework to measure the timeliness of radiology and microbiology reports within a healthcare system, and further measured time delay for detection of a single IA case.

Methods

We retrieved data from our Health System Resident Component (HSRC)[1], located at the UPMC health system, which receives HL7 messages in real time and records receipt time. The study period was from Oct. 1, 2004 to Oct. 1, 2005. The dataset contains data from four UPMC hospitals: 115,432 ED registrations, 285,372 radiology reports and 401,044 microbiology reports.

We performed data linkage, *i.e.*, linking the radiology and microbiology reports to the same ED visit, by using a *visit number*, which is an internal unique number for a patient visit.

We measured timeliness of a data type (e.g., radiology report) as the delay between patient registration in an emergency department (ED) and receipt of data type by HSRC. Let t_0 be the ED registration time, t_1 be the receipt time when the first report associated with the ED visit was received by HSRC and t_2 be the final receipt time when the last report associated with the ED visit was received by the HSRC. Δt_1 ($=t_1-t_0$) represents the delay time for receiving the first report and Δt_2 ($=t_2-t_0$) represents the delay time for receiving the final report. We defined lower bound of median delay time for diagnosis as *LMDT=Max{median Δt_1 of radiology reports, median Δt_1 of microbiology report}* and upper bound of median delay time for diagnosis as *UMDT=Max{median Δt_2 of radiology reports, median Δt_2 of microbiology reports}.*

Results

Table 1 shows timeliness of radiology and microbiology reports from the four UPMC hospitals. The overall LMDT for the four hospitals was 36.75 hours (=max(36.75, 35.12), ~1.5 days) and the overall UMDT for the four hospitals was 152.44 hours (=max(56.38, 152.44), ~6.4 days).

Table 1. Timeliness (in hours) of radiology and microbiology reports.

Hosp. ID	Median Rad. Δt_1	Median Micro. Δt_1	Median Rad. Δt_2	Median Micro. Δt_2
1	38.28	35.54	63.22	158.62
2	17.97	34.90	31.33	132.10
3	19.43	33.60	31.40	80.18
4	42.17	35.09	64.22	133.17
All	36.75	35.12	56.38	152.44

Discussion

The overall UMDT time (6.4 days) is close to the detection time of IA cases found in literatures including the recent IA case in PA.[3] The LMDT time (1.5 days) is of interest for biosurveillance, *i.e.*, biosurveillance systems can possibly (or stretch to) detect IA cases as early as the LMDT time. Manual case reporting however may introduce longer delay due to the delay between data receipt and review time. This study may benefit CDC's Biosense, which is actively collecting hospital data including the two data types, for estimating LMDT within each healthcare system. The results may also help outbreak planning and outbreak model simulation.

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