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Major Article

Delayed tuberculosis diagnosis and costs of contact investigations for hospital exposure: New York City, 2010-2014

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Background: A delayed diagnosis of tuberculosis (TB) in the hospital may lead to nosocomial exposure, placing employees and other patients at risk. A lack of prompt infection control measures for suspected cases at the time of admission may require complicated and expensive contact investigations. The purpose of this study was to estimate the person-hour costs required by infection control staff to investigate a single hospital-based TB exposure.

Methods: Electronic data were extracted from 2 tertiary hospitals and 1 community hospital in a large health care system in metropolitan New York City to identify pulmonary TB cases unsuspected at admission. All cases were reviewed by infection prevention and control (IPC) staff to identify exposures.

Results: From 2010-2014, 34 pulmonary TB cases which necessitated a contact investigation were identified. IPC staff calculated an average of 15-20 hours of work per exposure plus 30 minutes of follow-up for each exposed staff member. For exposures, time from admission to isolation averaged 3.3 days, with a mean of 41 staff exposed per patient and an approximate resource usage of 38 person-hours.

Conclusions: Contact investigations are costly to the health care system. In a low-prevalence country, such as the United States, it is still important that health care providers are trained to think TB.

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In New York City (NYC), the incidence of tuberculosis (TB) has been steadily decreasing since a peak in the mid-1990s.¹ One negative consequence of this otherwise positive trend is that health care providers have less experience with TB and thus have a lower index of suspicion, which may lead to a delayed or missed diagnosis.² Further, not all TB patients present with the classic symptoms of coughing and chest pain, but may present with more generalized symptoms of fever and weight loss.³ This may also lead to a delay in treatment and placing the patient on airborne isolation.⁴ Previous studies have indicated that delayed diagnosis is the principal

cause of nosocomial TB transmission.⁵⁻⁸ With a rate of 7.1 cases per 100,000 persons, NYC continues to be a higher burden region compared with the U.S. national rate of 2.96 per 100,000 persons, requiring clinicians to maintain a high index of suspicion for TB.¹

The Centers for Disease Control and Prevention (CDC) indicate that a contact investigation should be performed if the presumed index patient was determined to have confirmed or suspected pulmonary, laryngeal, or pleural TB and appropriate isolation precautions were not taken at the time of hospital admission.⁹ Necessary infection control measures include placing a surgical mask on the patient prior to their admission into an airborne isolation room with negative pressure and N-95 masking by health care professionals.¹⁰ Once TB exposure is presumed, a complicated and resource-intensive contact investigation often ensues.

There is a scarcity of research on the resources required by the health care system when a TB exposure is identified. The specific aims of this retrospective study were to identify hospital-based TB exposures documented over a 4-year period in an urban hospital system and estimate the person-hours required to conduct a hospital-based contact investigation for each exposure.

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Conflicts of interest: None to report.

METHODS

Study design

To first identify exposures, we conducted a retrospective analysis of adults with culture-confirmed pulmonary TB admitted between January 2010 and December 2014, which were unsuspected at hospital admission.

Identification of TB cases

Electronic data were extracted from 2 tertiary hospitals and 1 community hospital in a large health care system in Manhattan. All 3 hospitals were under the same health care system and therefore followed the same infection prevention and control (IPC) procedures for exposure management. Two sources of data were used to conduct the retrospective review of the medical records. The first was a database of >500,000 discharges from the health care system collected between 2010 and 2014 as part of a National Institutes of Health-funded study (grant no. 5R01NR010822). The second source of data were the hospital medical records, including microbiology results, and the IPC department personnel and exposure records.

Inclusion criteria for the first database included persons who were classified as TB-positive with unsuspected diagnosis at hospital admission if culture-positive for TB and placed on the anti-TB regimen of at least isoniazid and rifampicin >3 days after admission. The CDC recommends that drug therapy should be initiated before smear and culture results when clinical suspicion for TB is high¹¹; therefore, the absence of anti-TB treatment within 3 days of admission was used as a possible indicator of delayed diagnosis. Exclusion criteria for the first database included the following: extrapulmonary TB, non-mycobacterium TB, or <18 years of age. Extrapulmonary TB and pediatric cases were excluded because of a decreased likelihood of infectivity.⁹ Analysis of the first database resulted in 59 cases of TB-positive with unsuspected diagnosis at hospital admission, which were then compared with the second source of data, the IPC exposure records, to compile the final sample for the study. Inclusion criteria for the second database included previous documentation of an exposure workup by the IPC department. The TB exposure identification process used by the IPC department is provided in the following section. From the second data source, we collected data on time from hospital admission to airborne isolation, time to TB diagnosis, acid-fast bacilli (AFB) status, and number of staff exposed per patient and roommates exposed, if available.

Clinically, the TB identification process at the study site involves taking 3 sputum samples a minimum of 8 hours apart, with at least one in the early morning. Sputum samples are sent for AFB smear and culture. Smear results return in 1 day, and culture results can take up to 6 weeks. Positive AFB smears are automatically sent for nucleic acid amplification test (NAAT) using the Xpert MTB/RIF (Cepheid, Sunnyvale, CA), as were negative smears with a high index of suspicion from the clinician. NAAT results are also available in <24 hours. For the purposes of this study, the day of positive TB identification comes from either the NAAT or culture results.

Identification of TB exposures

Hospital-based TB exposures are discovered retrospectively. Once a patient who was not suspected to have TB at admission is diagnosed TB-positive by culture or NAAT, IPC staff review medical charts to determine if the case qualifies for a TB exposure. TB exposure is defined as a patient with (1) high infectivity who was not placed on airborne isolation precautions within an hour, or (2) low infectivity who was placed on precautions within 8 hours. The NYC

Department of Health (DOH) considers an exposure to be ≥ 8 hours without appropriate airborne precautions, but the study institution has a more conservative approach for exposure management by accounting for possible exposure in <8 hours among highly infective patients.¹² The IPC department defines high infectivity as individuals who have an AFB-positive smear and/or cavitory disease and low infectivity as individuals who are AFB-negative and have no indication of cavitory disease. Additional considerations of degree of infectivity include symptomology of patient (ie, active coughing) and whether staff came in close contact with the patient. Close contact was defined as any activity that required direct care of patients. The CDC lists health care workers with unprotected exposure to a patient with TB disease before the identification and correct airborne precautions of the patient as high risk for exposure.⁹ These considerations enable the IPC department to determine which staff to include in exposure workups. Once a TB exposure is confirmed by an IPC practitioner, an extensive review of the index case medical records and microbiology reports are completed. Exposures are followed 3 months back to determine if the patient had a past admission within the health care system. The exposure management approach is discussed with the hospital epidemiologist, and the case is reported to the NYC DOH, with serious cases reported to the State.

Person-hour costs of exposure

The IPC staff manage investigations of all suspected TB cases and possible staff exposures using a multidisciplinary approach. The infection preventionist completes an extensive chart review to extract names of staff contacts documented in the electronic medical records. Once complete, the names are forwarded to occupational health and the patient care director of the unit. The director is asked to identify those staff members who may have been exposed but did not chart in the electronic medical record. Once the list is completed and exposure is confirmed, IPC personnel e-mail all exposed staff members a document explaining the exposure management process and a date for their postexposure management visit. At this time, IPC staff often field questions from concerned staff members. The IPC staff also identify roommates, visitors, and any other potentially exposed patients and provide this information to the DOH for follow-up after hospital discharge.

Once the initial correspondence with exposed staff has occurred, the occupational health team takes over, logs approximately 30 minutes of time per assumed staff exposure, and conducts TB testing within the window period of 8-10 weeks after the last date of the exposure. The follow-up includes placement and reading of the purified protein derivative TB skin test. Staff members with a history of being purified protein derivative-positive require an occupational health visit and an 8- to 10-week postexposure visit to determine whether the staff member is symptomatic for TB.

There was a lack of literature on previous methods to calculate the person-hours required to investigate a single hospital-based TB exposure. To estimate the person-hours for this study, IPC staff individually wrote a list of activities required during a typical exposure investigation along with the approximate time for each task. Lists of activities and time were compared, and discussion ensued until agreement was reached.

RESULTS

Over a 4-year period, we identified 59 cases of pulmonary TB meeting our inclusion criteria. Of these, 34 had been recorded as exposures in the IPC data (Table 1). The remaining 25 cases were those that had not started anti-TB treatment >3 days after admission, but had been placed on airborne isolation <8 hours after

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