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Major article

Nosocomial tuberculosis exposures at a tertiary care hospital: A root cause analysis

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Key Words:
Quality improvement
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Background: Exposure of health care workers (HCWs) to patients with active TB continues to occur despite implementation of TB control policies.

Methods: We conducted a root-cause analysis of TB exposures at a tertiary care hospital. Clinical and management details of all confirmed cases identified in 2011 were summarized. Cases were independently reviewed by an expert panel that determined the type (ie, delay in initiating, incorrect use of or premature removal of control measures), preventability, and root cause(s) of each error (exposure).

Results: Fifteen cases were reviewed. Ten errors were identified in 7 (47%) cases. Cases associated with errors were older than those without errors (68 y vs 40 y; $P = .037$). Most cases (12/15) were foreign born. A delay in initiating airborne precautions accounted for 70% (7/10) of the errors. The expert panel determined that 80% (8/10) of the errors were preventable or possibly preventable. The most common root causes were failure to consider TB and failure to obtain and interpret imaging. Advanced age, atypical presentation, and presence of comorbid illnesses were common among the preventable cases.

Conclusions: TB control policies do not prevent all exposures. Our findings suggest that consideration of TB in elderly patients with risk factors, even if their signs and symptoms can be explained by an alternative diagnosis or are atypical, followed by a review of imaging studies, can further reduce this risk.

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Health care workers (HCWs) are at increased risk of exposure to tuberculosis (TB) and have a higher incidence of latent TB compared with the general population.[1-6] Recognition of TB as an occupational risk of health care has led to the implementation of administrative, environmental, and personal protective control strategies in health care institutions, which has produced significant reductions in TB transmission within hospitals.[4,6,7] Despite implementation of these measures and recent evidence demonstrating that the risk of latent TB in US HCWs is now near the population average, episodes of nosocomial TB transmission and outbreaks continue to occur.[4,7-12]

St Michael's Hospital (SMH) is a 450-bed urban teaching hospital in Toronto, Canada that has a dedicated TB clinic and serves a patient population at increased risk for TB. Despite the implementation of TB control policies and procedures at SMH, unprotected exposure of HCWs to patients with active pulmonary TB continues to occur, putting HCWs at risk of TB acquisition and prompting complex infection control and occupational health investigations.

We postulated that common errors in our approach to the diagnosis and treatment of TB resulted in these exposures. To identify these errors, we examined all exposure events occurring in 2011.

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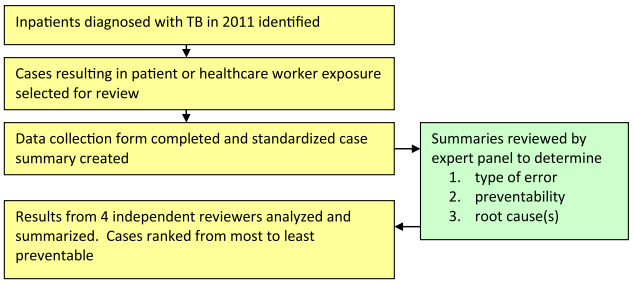

Fig 1. Summary of the evaluation process for review of inpatient cases of TB requiring exposure investigation.

METHODS

Study design

We conducted a root-cause analysis of all patients seen in the Emergency Department (ED) and/or admitted to the hospital and subsequently diagnosed with active pulmonary TB between January and December 2011 to identify any preventable errors that resulted in the exposure of HCWs to TB. The analysis was approved by the hospital's Research Ethics Board.

Identification of cases and definition of TB exposure

Patients with culture-proven pulmonary TB were identified from the hospital's microbiology and infection control databases. As TB is publicly reportable in our jurisdiction, and because Toronto has a centralized public health program that investigates all cases of TB, we believe that we captured all patients admitted to our hospital with active pulmonary TB, even if laboratory confirmation was performed at another facility.

A TB exposure meriting a preliminary investigation was defined to have occurred if a HCW, visitor, or patient spent any amount of time within the same patient room as a patient with active pulmonary or laryngeal TB in the absence of appropriate airborne precautions (ie, use of a N95 respiratory and negative pressure ventilation).

A significant exposure meriting follow-up tuberculin skin testing (TST) was further defined as an exposure occurring where the risk of transmission of TB to one or more individuals was determined to be significant. This assessment was made on a case by case basis by our infection prevention and control service using an algorithm that evaluates level of risk based on accepted predictors of infectiousness (eg, smear positivity, cavitary disease) and duration of exposure. In general, cumulative exposures of 0-8 hours were considered significant depending on the level of risk assigned by the infection control service and the performance of cough inducing procedures. Such exposures were considered significant if they occurred after the onset of symptoms or up to 3 months before the onset of symptoms or initial positive microbiological test, whichever occurred earlier.

Data collection

Infection control, occupational health, and microbiology records were evaluated to determine the number of inpatients and ED patients diagnosed with active pulmonary or laryngeal TB during 2011, the number of cases resulting in significant exposures, the number of individuals requiring a TST as part of an exposure investigation, and the number of TST conversions identified among HCWs, visitors, or patients.

For each index patient resulting in an inpatient exposure, a chart review was conducted to identify epidemiologic risk factors for TB, clinical presentation, radiographic findings, culture and sensitivity results, and treatment and treatment response. Risk factors assessed included country of origin, previous active or latent TB infection, ethnicity, homelessness, institutionalization, and immunosuppressive conditions (eg, HIV, organ transplantation). Additional information recorded included the date of initiation and discontinuation of airborne precautions and the rationale for each decision, if documented.

In addition, investigation around each exposure included a review of all inpatient and outpatient visits during the 3-month period before the onset of symptoms and/or initial positive specimen (whichever occurred earlier); the number and duration of all exposures; the date and type of all infection control precautions initiated or discontinued and the rationale for all such decisions, when documented; and the results of any follow-up tuberculin skin test results among exposed HCWs and patients.

Root cause analysis

Using all of the data collected above, for each case, a case summary was developed using a standard template (Appendix A). All case summaries were then sent independently, and in random sequence, to 4 independent reviewers with expertise in TB and public health, infection control, respirology, and infectious diseases. A standard questionnaire that accompanied each case summary asked each reviewer to determine the type of error that occurred, whether the error was preventable, and the root cause of the error (Fig 1).

The choices for type of error (resulting in exposure) were delay or failure to initiate airborne precautions, failure to adhere to or maintain airborne precautions, and premature discontinuation of airborne precautions. More than 1 type of error could occur for a given case. The choices for preventability included "preventable," "possibly preventable," and "not preventable." Preventable exposures were those in which best practices or guidelines were not followed and there were no extenuating circumstances to justify the approach taken (eg, a patient from a TB endemic country presented with 3 months of fever, night sweats, and weight loss, but chest radiography was not ordered and airborne precautions were not initiated). Possibly preventable exposures were those in which the guidelines and/or minimum standards of care were followed, but the exposure likely could have been prevented nonetheless. Exposures classified as not preventable were those in which best practices and good clinical judgment were used but extenuating circumstances or unusual features of the case resulted in exposure.

Finally, for each type of error, the reviewers listed 1 or more root causes contributing or potentially contributing to the error. The root causes of an error were defined as any action or omitted action that likely causally contributed to the error and that might provide a target for future interventions to prevent similar errors.

Statistical analysis

The Wilcoxon rank-sum test was used for comparisons of continuous variables, and Fisher exact test was used for comparison of proportions.

RESULTS

Overview of cases

In 2011, 15 inpatients were diagnosed with active pulmonary TB at our hospital. The basic epidemiologic features of these patients are summarized in Table 1. Thirteen of the 15 patients (87%) were

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