

# Tuberculosis exposure in an oncology clinic and hospital environment: Not all exposures are equal

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## KEY WORDS

TB, healthcare, contact investigation

## BACKGROUND

### A. Index Case Description

A 57-year-old patient was diagnosed with pulmonary tuberculosis while undergoing routine treatment for metastatic neural endocrine cancer of the gastro-intestinal tract at a 495-bed, university-affiliated medical center. TB infection in this patient was undiagnosed for several weeks. The patient did not have any hemoptysis but had weight loss, cough and shortness of breath. Her clinical presentation and chest X-rays findings were suspected to be related to her metastatic cancer. The chest X ray revealed left upper and lower lobe cavitation. CT scan of the chest confirmed the cavitation with multiple nodules and enlarged mediastinal adenopathy. Abdominal CT revealed multiple hepatic metastases. The serial imaging was suspicious of advancing metastatic cancer. Consequently, other hospital patients in the oncology, radiology and emergency outpatient departments were exposed to TB. In response to this exposure, the Infection Prevention (IP) department conducted a TB contact investigation. **Figure 1** summarizes the timeline of the index case at the hospital. By September 21, 2015 all three sputum smears had returned from the laboratory as positive and treatment for *Mycobacterium tuberculosis* (MTB) was initiated. The patient was discharged home on September 23 after a brief in-patient stay. Her cultures were confirmed as pan susceptible MTB.

### B. Contact Investigation & Need for Follow-up

The infection control department initiated a contact investigation after TB diagnosis was confirmed. A review of each

patient contact using both inpatient and outpatient records from Aug. 4 till Sept. 16, 2015 was conducted. We collected exposed patients' demographics, comorbidities and risk factors to provide further insight into this cohort. The rate of TST compliance among patient contacts can provide insight into the effectiveness of the current contact notification methodology and determine if new methods should be adopted to improve outcomes.

### C. Algorithm Development

There was no comprehensive TB contact investigation algorithm available for use within the study hospital system. The development of an algorithm for use by professional infection control practitioners and clinicians as a guide in future exposure was urgently needed to streamline contact investigation processes and ensure all appropriate actions are implemented to protect the health of patients and staff alike.

### D. Background Information

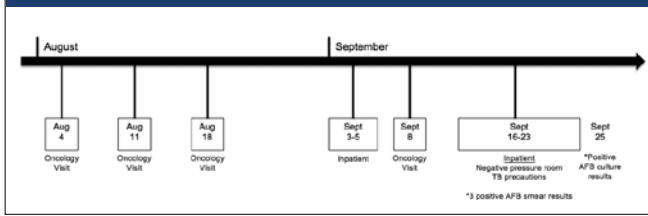
#### Post-exposure clinical outcome

Exposure to *MTB* results in one of these outcomes: no infection, latent tuberculosis infection (LTBI), or direct progression to active disease. Spread of *MTB* is strongly related to positive *MTB* smears, cavitory lesions and the presence of cough, which occurs in subset of active TB cases but not LTBI. Immune compromised individuals with LTBI are at higher risk for developing active TB than general population (1,2). Direct progression after exposure to active disease is possible with prolonged exposure especially in immune suppressed individuals (HIV-AIDS specifically).

**Conflict of interest:** There was no financial support for this project.

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**FIGURE 1: Timeline of the Index Patient at the Hospital Before Diagnosis**



### Tuberculosis transmission in hospital settings

The World Health Organization (WHO), states that health care workers (HCW) have a 7-10 times incidence of TB infection compared to general population (3,4). Nosocomial TB is a significant risk for healthcare workers (HCW) and patients, alike (5,6). This risk certainly varies depending on the prevalence of TB in the geographic area as well as in outbreak vs. endemic conditions. TB contact investigation is an effective epidemiological method focused on breaking the chain of infection transmission. Early detection of exposed individuals using LTBI methods Tuberculin skin test (TST) or Interferon Gamma release assay (IGRA) and offering LTBI therapy is very effective in preventing active TB.

### METHODS

This is an observational epidemiological study describing and analyzing a TB contact investigation that was conducted at a 495-bed health care facility (that includes an outpatient Oncology Center). The institutional review board (IRB) of the university medical system approved this project as a quality improvement study (Project ID: 682). The researchers were required to have a *Health Insurance Portability and Accountability Act* (HIPAA) agreement to maintain confidentiality of any records reviewed for this study.

### Contact Investigation Description

In this event, Infection Control and Employee Health Departments monitored all patients and HCWs who were potentially exposed. A list of patient's contacts was compiled by acquiring patient visitation logs according to date from the oncology, radiology and emergency departments. Exposure periods were set based on the index patient's appointment times. All those seen in the Oncology, Radiology and Emergency departments within one hour time-frame before or after the index patient's appointment in the waiting and treatment rooms were considered as contacts. Based on these criteria, infection preventionists (IP) identified potential exposure of 142 patients and 60 HCW. IP contacted all exposed patients with a notification letter sent via certified mail. The letter informed contacts about the potential exposure to TB and advised them to see their primary care physician for TST testing. On October 13, 2015, IP sent all notification letters to patient contacts, 18 days after confirmation that the index case was culture positive.

TST was performed once as it was performed at least eight weeks after exposure. The exposed patients' charts were reviewed for; age, gender, race, zip code, height, weight, BMI, exposed visitation date(s), reason for visit(s), hospital location, discharge

diagnoses, Charlson Comorbidity Score (17), returned notification letter, completion of TST test, results of TST test, completion of chest X-ray, diagnosed with HIV and smoking status.

Data analysis was performed using Stata/SE 12.1. Summary and descriptive statistics are given for patient demographics and testing performed. Frequency and percentage are presented for categorical variables, including race/ethnicity, gender, TST testing and TST results. The mean is presented for continuous variables, including age, BMI and Charlson Comorbidity Index score.

### RESULTS

#### A. Contact Investigation Results

A total of 202 individuals were identified as potential contacts. IP and Employee Health identified 142 patients 60 HCW. IP contacted 84.5% (n=120) of all patient contacts successfully; 15.5% (n=22) of the patient contacts were lost to follow up; 20 patient letters were undeliverable/returned to sender and two individuals died prior to the start of exposure notifications. The cause of death was not related to TB exposure.

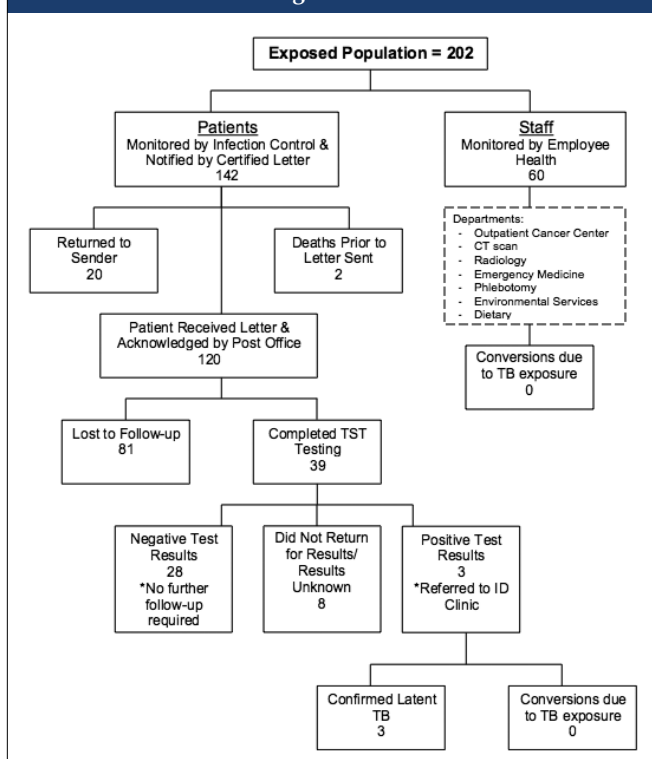
Of the 120 patients successfully notified, 32.5% (n=39) completed TST testing and the remaining 67.5% (n=81) of patients did not respond. 71.8% (n=28) of patients who complied with the recommended testing had negative TST results and required no further follow-up. 20.5% (n=8) of patients who underwent TST had no results recorded in their electronic chart. We reviewed all outpatient and inpatient electronic records using their perspective software. The remaining 7.7% of test compliant patients (n=3) had positive TST results. The three patients were referred to the Infectious Disease Clinic. Upon further evaluation, all three patients were confirmed to have latent tuberculosis infection (LTBI) from previous exposures and were not a result of the recent nosocomial exposure. One patient described having a positive TST years ago, but we did not have the records. The second patient was born in China in 1952 and describes having BCG vaccination and positive TST previously. The third patient had a reaction (erythema rather than induration) was suspected to be false positive and interferon gamma release assay was negative.

Employee Health identified 60 staff members from the following departments: cancer center, radiology, emergency medicine, phlebotomy, environmental services, dietary and CT scan. All healthcare workers had a negative TST base line and the Employee Health Department confirmed there were no conversions due to the TB exposure. The results of the contact investigation conducted are depicted in **Figure 2**.

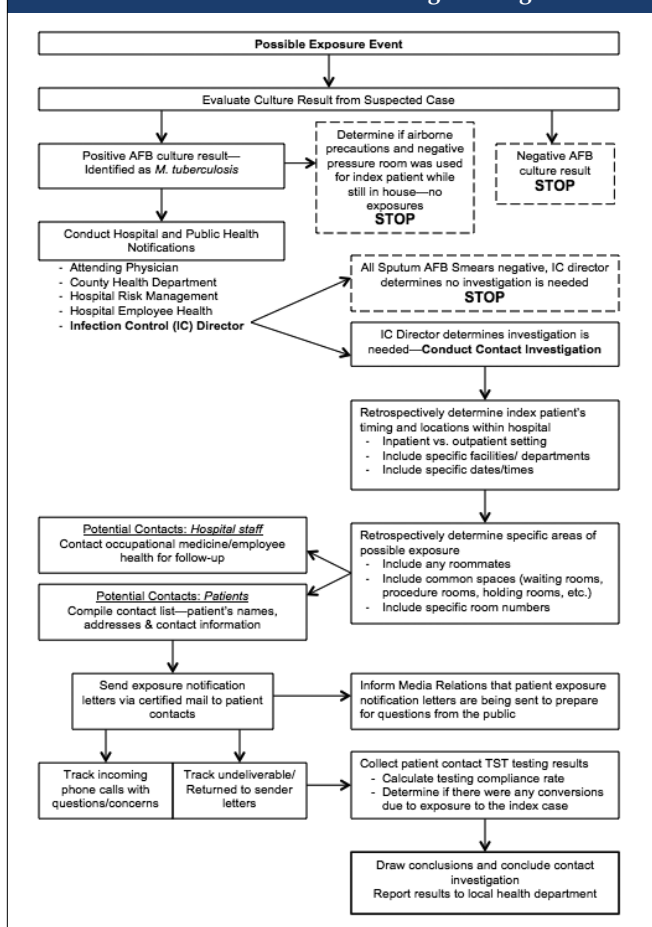
#### B. Patient Demographics

The mean age of the patient population is 55.1 years. The patient population has a mean BMI of 29.3; this puts the average individual at the border of overweight and obese. The mean Charlson Comorbidity Index is 4.2; this shows that this is a sick population facing numerous chronic conditions. Males represent 45.8% and females represent 54.2% of the patient population. The race/ethnicity composition of the exposed population is as follows: 16.2% African American, 81.7% white, 0.7% Asian and 1.4% not listed. Additionally, Oncology patients (n=67) represented 47% of the patient exposures.

**FIGURE 2: Contact Investigation Results**



**FIGURE 3: Tuberculosis Contact Investigation Algorithm**



**C. Testing Compliance and Conversions**

Only 27.5% (n=39) of patient contacts complied with the recommended testing. However, as discussed above, 20 patient letters were returned as undeliverable and two patients died prior to the start of the investigation. Therefore, only patients who successfully received the notification letter were included in TST compliance rate calculation. When considering the 120 patients who successfully received the notification letter, 32.5% (n=39) complied with the recommended testing and 67.5% (n=81) were lost to follow-up. This information is shown in **Table 1**.

**D. Algorithm Developed**

The algorithm for Tuberculosis Contact Investigation was developed in response to this case study review by mapping out all activities needed to complete a thorough contact investigation. The developed outline involves stakeholders at all levels of the institution and community. It also ensures that all exposed patients are included in the investigation and incorporates the completion of a final report to conclude the contact investigation. The algorithm developed has potential to be a beneficial tool for IPs to use as guide in future exposure events in an organized and systemic manner. The algorithm is shown in **Figure 3**.

**DISCUSSION**

The United States (US) is classified as a low TB incidence country. Foreign-born individuals constitute the majority of TB cases with prevalence varying geographically within the US (3). Health care facilities are required to have a written facility plan for all tuberculosis infection control activities (7). According to the World Health Organization, those who live or work in congregate settings, such as hospitals, nursing homes or prisons, have a greater incidence of TB infection than the general population (8). The risk of obtaining nosocomial TB is true for both healthcare workers (HCW) and patients (9). Specifically, HCWs are at higher risk of acquiring TB than the general population (6). TB transmission within a health-care setting is risky as spread could occur via infected HCWs and morbidity and mortality is higher in patients as compared to the public. However, healthcare facilities typically have a well-defined community and expertise to run investigations effectively and quickly.

The low testing compliance rate of 32.5% limited the complete identification of all potential conversions. This finding is consistent with other published studies (10). A study of a TB exposure within an Emergency department waiting room showed that less than one-third of non-staff complied with the recommended testing. The low testing compliance of this contact investigation has a significant implication for infection control. Adoption of new methodologies for patient contact notification will allow for early detection of new TB infection. Patients' primary care providers may be able to encourage their patients to adhere to testing recommendations. Moreover, calling patients individually in addition to sending letters via certified mail may improve the number of patients successfully notified. The use of social media could be helpful to reach out to patients but needs appropriate confidentiality clearance (11).

**TABLE 1: TST Testing Compliance in exposed patients**

Completed TST Testing	Entire Population		Successfully Notified	
	Count	Percentage	Count	Percentage
YES	39	27.5	39	32.5
NO	81	57.0	81	67.5
Unable to contact*	22	15.5	--	--
Total	142	100%	120	100%

\*(Letter undeliverable/died prior)

Contact investigation led to the identification of three previously unknown cases of LTBI. These three LTBI cases represent 9.67% of the patients with known testing results, which emphasizes the importance of TB screening among high-risk populations, such as oncology patients. As previously discussed, immunosuppressed patients such as those with HIV infection, undergoing chemotherapy and radiation, or transplant recipients on immunosuppression medications are at greater risk of developing active tuberculosis from a latent tuberculosis infection (LTBI) (12). This investigation emphasizes the importance of screening for LTBI to identify and treat TB infections earlier rather than later.

In this investigation, we found no detected conversions because of the exposure to the index patient. In some TB exposure data, infection was reported to be to be 25-50% (5, 13-17). The exact incidence of TB transmission within health care settings varies considerably depending on the length of exposure, air circulation and how crowded the health care facility is. This exposure was predominantly a brief outpatient exposure (oncology office) with few inpatient exposures. The contacts had mostly short exposure with very few individuals who had significantly long exposures. This may be a reason for the no conversions seen in our study. Longer hospital exposures were associated with high rate of conversions (14, 18). Latent TB patients are affected by the prevalence of TB in the community, which could have been falsely reported as due to the exposure (due to lack of base line TST / IGRAs testing) (15, 17, 19).

This study has important limitations; first, this is a short-term observational study with emphasis on outpatient exposures that may not be generalizable to all healthcare settings. Second, the low compliance of patient notification – which is typical in contact investigations – could have missed important data. The main strengths of this study are related to the excellent records of patients and HCW movements and exact exposure. Second, the clinical evaluation of all individuals who had positive TST. Third, our experience may be very similar to many other facilities in the US.

Finally, contact investigation conducted was highly resource intensive, predominantly personnel time. This is similar to other reported exposures (20). We developed an algorithm to assist in the conduct of TB exposures within health care facilities. Within large TB prevention policies, this algorithm could serve as a quick reminder for how to initiate an investigation.

## CONCLUSION

Our contact investigation was helpful in assuring patient safety (12). High awareness of the dangers of TB spread, decreased significantly the exposure duration and limited the spread of TB infection. This also highlights the importance of LTBI screening in high-risk populations for early detection and reduction of risk of open TB.

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