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Systematic contact investigation: an essential infection prevention skill to prevent tuberculosis transmission in healthcare settings

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Abstract

A systematic approach to contact investigations has long been a cornerstone of interrupting transmission of tuberculosis (TB) in community settings. This paper describes the implementation of a systematic 10-step contact investigation within an acute care setting during a multistate outbreak of healthcare-associated TB. A systematic approach to contact investigations might have applicability to the prevention of other communicable infections within healthcare settings.

Keywords

healthcare-associated infection; tuberculosis; contact investigation

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Background

Contact investigations aim to prevent propagation of contagious diseases through the identification of exposed individuals, implementation of prevention measures, and monitoring for disease development. The Centers for Disease Control and Prevention provides a framework for a systematic approach to contact investigations which has long been a cornerstone for interrupting transmission of tuberculosis (TB) in the community.[1] This paper describes our implementation of a 10-step systematic contact investigation modified from those used in community settings for use in a large acute care facility during a multistate outbreak of healthcare-associated tuberculosis (TB).[2]

In May 2021, two spinal surgery patients at our healthcare facility developed TB disease, spurring a local outbreak investigation (Figure 1). In early June 2021 the Centers for Disease Control and Prevention initiated work with state health departments to identify recipients of viable bone graft matrix suspected to be contaminated with *M. tuberculosis*. One hundred thirteen individuals had received implants with the contaminated material, 8 deaths had occurred, 3 of which were attributed to receipt of the product. Treatment for TB disease was initiated for the remaining 105 recipients.[2]

On June 4, 2021, the Indiana Department of Health notified our facility that the manufacturer of bone allograft implants received by the two spinal surgical patients had issued a voluntary recall due to suspected contamination with *M. tuberculosis*.[2] Our facility's tissue bank confirmed that during March 3–April 5, 2021, 11 adult spinal surgery patients had been implanted with units from the recalled product lot. All 11 were considered case patients with TB disease. Treatment for TB was initiated by the Indiana Department of Health, and a contact investigation was indicated.[3] We implemented a modified systematic 10-step contact investigation among potentially exposed healthcare personnel (Figure 2).

Ten steps of a systematic contact investigation within an acute care facility[1]

1. Initiate collaboration between the healthcare facility and public health

Due to the multistate nature of the outbreak, our facility had ongoing communication and collaboration with the Allen County Department of Health, the Indiana Department of Health, and the Centers for Disease Control and Prevention (CDC). Collaboration included defining exposures, identifying potentially exposed patients and healthcare personnel (HCP), offering TB testing, and evaluating those with positive TB tests.

2. Review existing information about the case patients

We used the facility's electronic health record to compile a line list of the 11 case patients, and basic information about them and their care providers. Dates of initial and revision surgeries were confirmed, inpatient and outpatient medical care visits were identified, documentation of medical and other care providers, and discharge to other facilities was noted.

3. Determine an initial estimate of the infectious period and degree of infectiousness for each case patient

We defined the beginning of each case patient's infectious period as the date of surgical implantation of contaminated bone allograft product. Handling of specimens containing *M. tuberculosis* is a known hazard that can be modified using biosafety measures.[4] The risk to surgical personnel present during implantation may have been like that of handling a specimen of *M. tuberculosis* with suboptimal protective measures (e.g., wearing a surgical mask rather than N95 respirator or higher level of respiratory protection). A literature review indicated that tuberculin skin test conversions among HCP providing post-surgical care to patients with draining tuberculous lesions ranged from 5% to 38% in previous outbreaks.[5–9] Previously reported care activities associated with skin test conversion included wound irrigation, debridement, and dressing changes.[5–9]

4. Conduct observations of practices for potential routes of exposure

Focused case reviews were conducted to identify potential routes of exposure to *M. tuberculosis* among case patients and HCP. Additional detailed information about each case patient included services received from ancillary departments (e.g., radiology, phlebotomy), movement within the facility, and the presence of roommates.

Observations of surgical procedures using non-recalled products identified potential for aerosolization of *M. tuberculosis* throughout the procedure, beginning when the graft matrix was prepared for implantation, throughout the surgery, and during postoperative care. Following surgery, grossly contaminated cannulated surgical instruments (e.g., Kerrison rongeurs) were decontaminated using heavy flushing and brushing in the sterile processing department. Patient care provided in the post-anesthesia care unit and inpatient units included emptying of Jackson-Pratt drains by generating a forceful stream of wound drainage. This drainage was then flushed in uncovered hoppers open to the patient beds or on inpatient surgical units in uncovered toilets.

We reviewed when and how CDC's recommended Transmission-Based Precautions, which include Standard and Airborne Precautions for patients with pulmonary TB, and Standard, Airborne, and Contact Precautions for patients with draining tuberculous wounds, were implemented. Following the initial surgeries, 2–3 months before the contaminated product recall, Standard Precautions were appropriately used, but the need for Airborne and Contact Precautions was not known. Following June 4, 2021, when one of the 11 case patients was readmitted for surgical revision of the infected site, we found that Airborne and Contact precautions were not always continuously maintained. The COVID-19 pandemic had altered the management of supplies for respiratory protection (e.g., N95 filtering face piece respirators), which were inconsistently available on the inpatient units housing these patients and frequently incorrectly worn (e.g., over beard, not recently fit-tested). Additionally, personnel regarded extrapulmonary TB disease as noninfectious and did not correctly appraise exposure risk associated with draining wounds.

5. Review information and develop a plan for the investigation

We determined that the contact investigation should include the perioperative department and HCP who provided inpatient care, including those that might have been present on a treating unit or those that provided outpatient ancillary care without the benefit of indicated engineering controls and respiratory protection. TB testing using an interferon-gamma release assay (IGRA), done upon hire or the most recent result, was considered the individual's baseline. To ensure healthcare personnel could easily access TB testing, we planned to collect IGRA specimens during influenza immunization clinics, offering clinic hours around shift change and providing testing on the unit, particularly for night shift staff.

6. Refine the infectious period and degree of infectiousness

The review of records and observations of practices identified over 200 patient-days of potential exposure for HCP at our facility beginning on March 3, 2021, the date of the first surgery, through July 30, 2021, when it was confirmed that all HCP had access to supplies for respiratory protection and were continuously using recommended Transmission-Based Precautions for inpatients with draining tuberculous wounds.

7. Identify and prioritize contacts

HCP who worked in the sterile or sub-sterile area of the operating room and the perioperative nursing staff were initially identified as a high priority for testing. Due to the heavy use of flushing and brushing to decontaminate cannulated instruments, sterile processing department personnel were also included in this high-priority group.

The focused case reviews identified additional priority groups of HCP and patients who overlapped in time or location (e.g., personnel working in perioperative areas, inpatient units) with case patients who were not continuously maintained on recommended Transmission-Based Precautions. Chart review was useful for identifying medical providers for prioritization, but other HCP may not have been documented in the medical record. Therefore, we estimated the duration of time HCP spent in direct contact with the case patients. Those with face-to-face contact for substantial periods of time (e.g., adult inpatient nursing, environmental services personnel) were given a high priority. Those with infrequent direct contact for short time periods (e.g., biomedical engineering, facilities) were considered medium risk, and those who did not enter patient rooms or have direct contact with these patients (e.g., administrative personnel) were considered low risk. Personnel that worked on units that did not provide care to case patients, and administrative personnel working in office spaces without patient contact were not considered to be at risk of exposure.

In addition to HCP contacts, three inpatient and outpatient groups with potential exposure were identified: (1) those in the post-anesthesia care unit at the same time or immediately following potential disposal of liquid wound drainage; (2) those sharing a room or pod (i.e., groupings of 4 private rooms with a shared central area) with one of the 11 patients before Transmission-Based Precautions were implemented; and (3) those receiving care at an outpatient wound clinic immediately following a case patient without time allotted for a full air exchange.

8. Conduct contact assessments

TB screening of the perioperative and surgical processing department personnel was considered a high priority and was initiated in June 2021 after the initial identification of exposure. testing of all other HCP, whose potential exposure occurred outside of the perioperative environment, began in September 2021, at least 8 weeks following their last exposure. Patients who met exposure criteria were notified twice by mail. The first letter was from the facility notifying them of their exposure, and a second one was from the local health department instructing them on how to receive free, confidential post-exposure testing.

9. Determine whether to expand or conclude an investigation

Due to low compliance during initial TB testing and additional exposures during revision surgeries, many surgical personnel required a second round of testing. We conducted broad-based testing of potentially exposed HCP on inpatient units, but the investigation was not expanded to other groups of HCP or patients. At completion, 33 HCP (1.5%) among the 2,197 screened were identified with new latent TB infections.[3] These individuals were offered free treatment for latent TB infection to prevent progression to TB disease.

10. Evaluate the contact investigation activities

Although adherence with testing recommendations was impacted by COVID-19 surges and associated staffing shortages, access to TB testing performed alongside influenza immunizations encouraged participation. An unanticipated challenge was related to phlebotomy staffing to obtain IGRA samples. Following this contact investigation, the annual Infection Prevention Risk Assessment was updated to require annual TB testing at the facility in 2022. The need for ongoing TB testing of healthcare personnel will be reassessed in 2023.

Discussion

Contact investigations are essential in breaking chains of transmission and protecting patients and HCP exposed to *M. tuberculosis* in healthcare settings. This complex and challenging investigation utilized the 10 steps of a systematic contact investigation,[1] but these steps were not always sequential. Because this contact investigation was performed during pandemic-related surges of COVID-19, staffing shortages affected our ability to rapidly test potentially exposed healthcare personnel.

This large investigation involved the facility, local, state, and federal resources. Senior leadership support was essential for allocation of resources within the facility. Collaboration with state and federal partners ensured a thoroughness which identified unusual routes of TB exposure. A clear division of responsibilities—with the hospital evaluating potentially exposed personnel and inpatients and the local health department providing evaluation of discharged patients—was essential for creating clear messages about where, when, and how to be evaluated.

The historical reductions in TB morbidity and mortality achieved through contact investigations form a foundational practice that may be applicable when other contagious infectious diseases occur in healthcare settings. Infection preventionists and hospital epidemiologists have clearly defined steps for outbreak investigations; frameworks for contact investigations within healthcare are not well described. A systematic method of contact investigation should be used to ensure that all potentially exposed individuals are afforded protection availed by the best available prevention measures.

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References

1. Centers for Disease Control and Prevention. Module 8: Contact investigations for Tuberculosis. Accessed January 31, 2023. https://www.cdc.gov/tb/education/ssmodules/default.htm
2. Schwartz NG, Hernandez-Romieu AC, Annambhotla P, et al. Nationwide tuberculosis outbreak in the United States linked to a bone graft product: an outbreak report. Lancet Infect Dis,22 (2022), pp. 1617–1625. doi: 10.1016/S1473-3099(22)00425-X. [PubMed: 35934016]
3. Li R, Deutsch-Feldman M, Adams T, et al. Transmission of *Mycobacterium tuberculosis* to healthcare personnel resulting from contaminated bone graft material, United States, June 2021-August 2022. Clin Infect Dis, 76 (2023). doi: 10.1093/cid/ciad029.
4. Jensen PA, Lambert LA, Iademarco MF, Ridzon R. Centers for Disease Control and Prevention. Guidelines for preventing the transmission of Mycobacterium tuberculosis in health-care settings, 2005. MMWR Recomm Rep. 2005;54(RR-17):1–141. Accessed March 8, 2023. https://www.cdc.gov/mmwr/preview/mmwrhtml/rr5417a1.htm?s_cid=rr5417a1_e
5. Hutton MD, Stead WW, Cauthen GM, Bloch AB, Ewing WM. Nosocomial transmission of tuberculosis associated with a draining abscess. J Infect Dis, 161 (1990), pp. 286–295. doi: 10.1093/infdis/161.2.286. [PubMed: 2105362]
6. Frampton MW. An outbreak of tuberculosis among hospital personnel caring for a patient with a skin ulcer. Ann Intern Med, 117 (1992), pp. 312–313. doi: 10.7326/0003-4819-117-4-312. [PubMed: 1637027]
7. Keijman J, Tjhie J, Olde Damink S, Alink M. Unusual nosocomial transmission of *Mycobacterium tuberculosis*. Eur J Clin Microbiol Infect Dis, 20 (2001), pp. 808–809. doi: 10.1007/s100960100606. [PubMed: 11783698]
8. D'Agata EM, Wise S, Stewart A, Lefkowitz LB Jr. Nosocomial transmission of Mycobacterium tuberculosis from an extrapulmonary site. Infect Control Hosp Epidemiol, 22 (2001), pp. 10–12. doi: 10.1086/501817. [PubMed: 11198015]
9. Stead WW. Skin Ulcers and Tuberculosis Outbreaks. An Intern Med, 118 (1993), p. 474. doi: 10.7326/0003-4819-118-6-199303150-00020.

Highlights:

- Contact investigations conducted within healthcare settings should utilize a systematic approach.
- This paper describes 10 steps of a systematic contact investigation used during the response to a multistate outbreak of healthcare-associated tuberculosis.
- The steps of a systematic contact investigation used for tuberculosis could be useful when conducting contact investigations of other communicable diseases within healthcare settings.

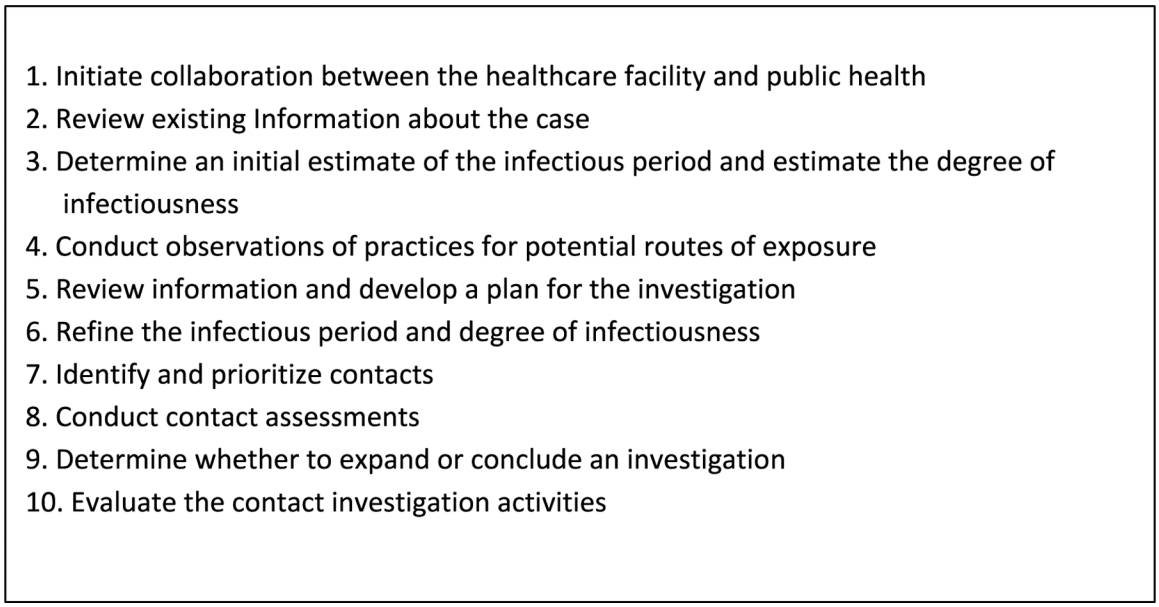

Figure 1:
Ten steps of a systematic contact investigation within a healthcare setting[1]

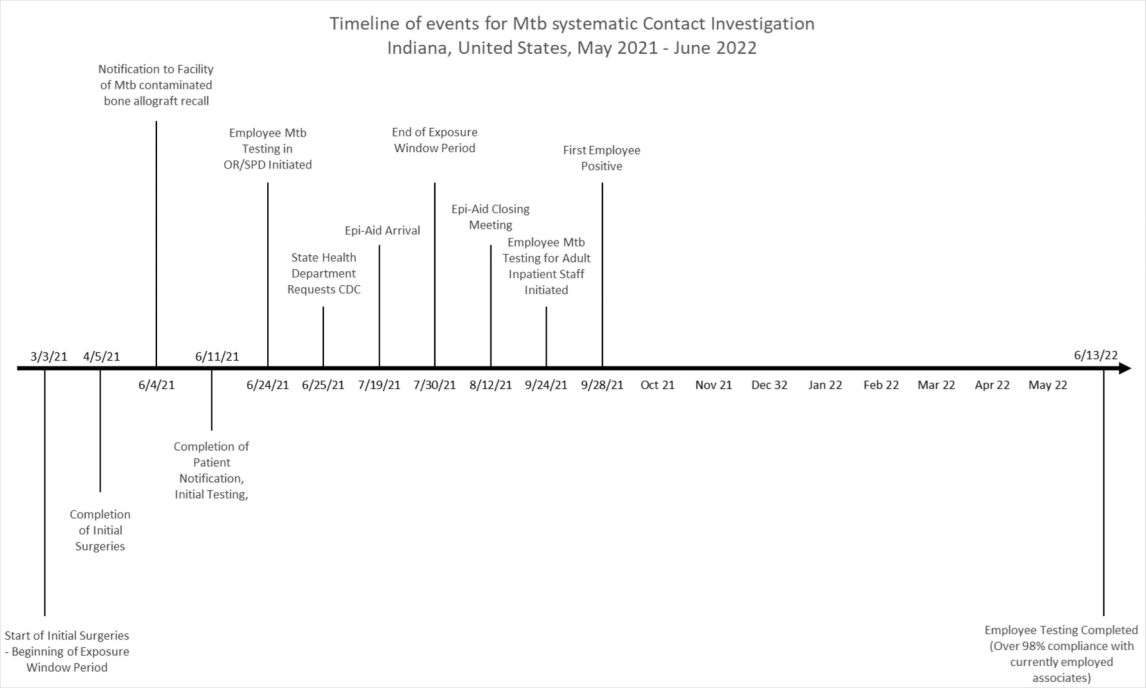

Figure 2:

Timeline of tuberculosis contact investigation related to a contaminated bone allograft product

Abbreviations: CDC = Centers for Disease Control and Prevention; Mtb = *Mycobacterium tuberculosis*; OR = operating room; SPD = sterile processing department.