Investigation of Contacts of Persons with Infectious Tuberculosis, 2005

National Tuberculosis Controllers Association

Centers for Disease Control and Prevention

Division of Tuberculosis Elimination

Centers for Disease Control and Prevention

Background (1)

- 1962: Isoniazid (INH) demonstrated to be effective in preventing tuberculosis (TB) among household contacts of persons with TB disease
  - Investigation and treatment of contacts with latent TB infection (LTBI) quickly becomes strategy in TB control and elimination in the U.S.
- 1976: American Thoracic Society (ATS) published guidelines for investigation, diagnostic evaluation, and medical treatment of TB contacts

Background (2)

- 2005: National TB Controllers Association (NTCA) and CDC release guidelines on the investigation of contacts of persons with infectious TB
  - Expanded guidelines on investigation of TB exposure and transmission, and prevention of future TB cases through contact investigations
  - Standard framework for assembling information and using findings to inform decisions

Contact Investigations – A Crucial Prevention Strategy

- On average, 10 contacts are identified for each person with infectious TB in the U.S.
- 20%–30% of all contacts have LTBI
- 1% of contacts have TB disease
- Of contacts who will ultimately have TB disease, approximately one-half develop disease in the first year after exposure

Benefits of Contact Investigations

- Finding and treating additional TB disease cases (potentially interrupting further transmission)
- Finding and treating persons with LTBI to avert future cases

Contact Investigation Responsibilities

- Health departments are responsible for ensuring the conduct contact investigations
- Contact investigations are complicated activities that require
  - Many interdependent decisions
  - Time-consuming interventions

Key Terms (1)

- Case – A particular instance of a disease (e.g., TB). A case is detected, documented, and reported.
- Contact – Someone who has been exposed to *M. tuberculosis* by sharing air space with a person with infectious TB.

Key Terms (2)

- Index – The first case or patient who comes to attention as indicator of a potential public health problem.
- Source case or patient – The case or person who was the original source of infection for secondary cases or contacts; can be, but is not necessarily, the index case.

Decisions to Initiate a Contact Investigation

Decisions to Initiate a Contact Investigation

- Public health officials must decide which
  - Contact investigations should be assigned a higher priority
  - Contacts to evaluate first
- Decision to investigate an index patient depends on presence of factors used to predict likelihood of transmission

Factors that Predict Likely Transmission of TB

- Anatomical site of the disease
- Positive sputum bacteriology
- Radiographic findings
- Behaviors that increase aerosolization of respiratory secretions
- Age
- HIV status
- Administration of effective treatment

Characteristics of the Index Patient Associated with Increased Risk of TB Transmission

- Pulmonary, laryngeal, or pleural TB
- Acid-fast bacilli (AFB) positive sputum smear
- Cavitation on chest radiograph
- Adolescent or adult patient
- No or ineffective treatment of TB disease

Behaviors of the Index Patient Associated with Increased Risk of TB Transmission

- Frequent coughing
- Sneezing
- Singing
- Close social network

Initiating a Contact Investigation (1)

- Consider if index patient has
  - Confirmed or suspected pulmonary, laryngeal, or pleural TB
  - Chest radiograph consistent with pulmonary TB
- Recommended if
  - Sputum smear has AFB on microscopy
  - Chest radiograph indicates presence of cavities in the lung (AFB sputum smear negative)

Initiating a Contact Investigation (2)

- Not generally indicated if
  - Sputum smear has AFB on microscopy and nucleic acid amplification (NAA) tests for *M.tuberculosis* are negative

Initiating a Contact Investigation (3)

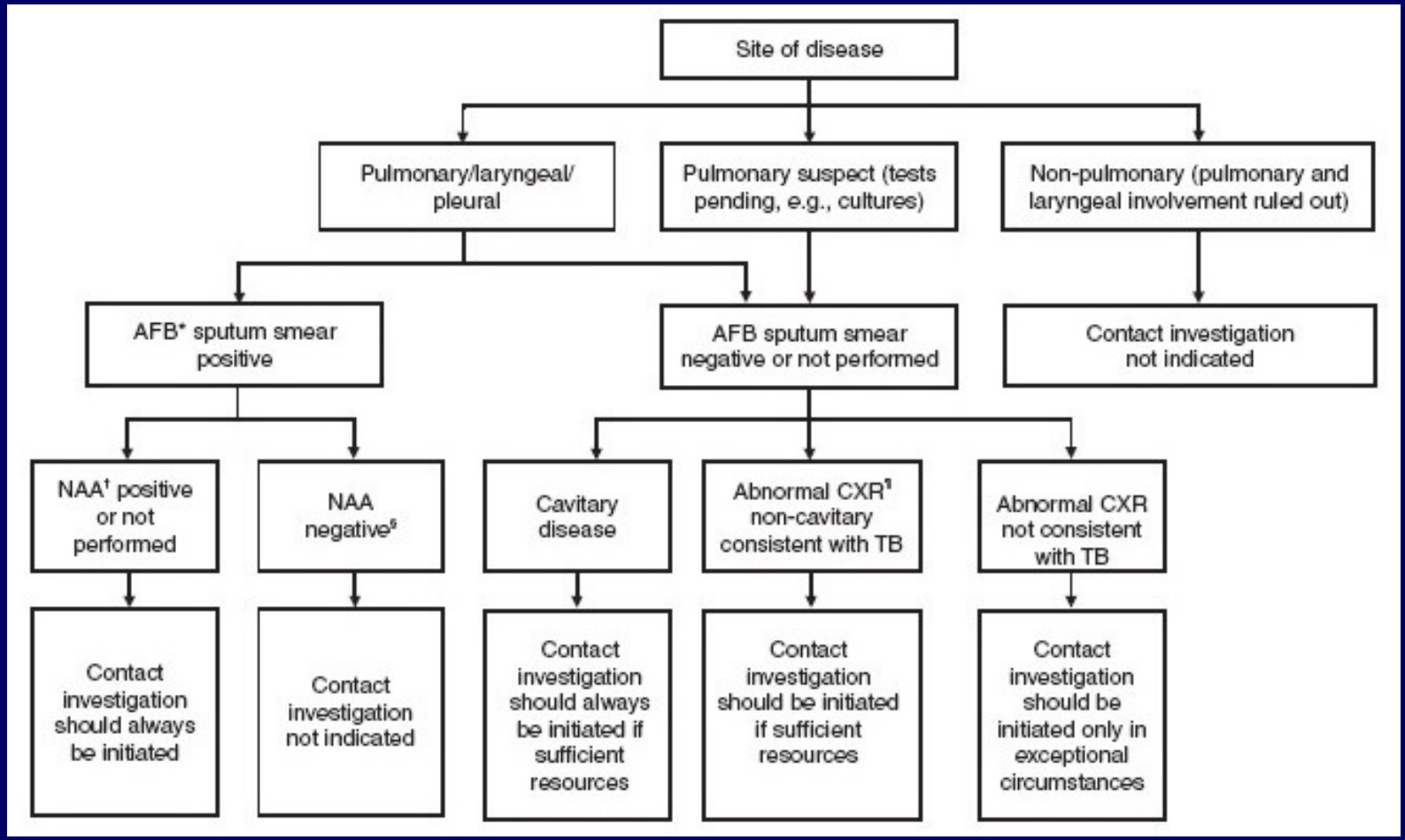
- Persons with AFB smear or culture-positive sputum and cavitary TB assigned the highest priority

- Should not be initiated for contacts who have suspected TB disease and minimal findings in support of pulmonary TB diagnosis

Initiating a Contact Investigation (3)

- Initiation of other investigations depends on
  - Availability of resources to be allocated
  - Achievement of objectives for higher priority contact investigations

Decision to Initiate a TB Contact Investigation



*Acid-fast bacilli
†Nucleic acid assay
§Approved indication for NAA
¶Chest radiograph

Investigating the Index Patient and Sites of Transmission

Comprehensive Index Patient Information

- Foundation of a contact investigation
- Information to be gathered includes
  - Disease characteristics
  - Onset time of illness
  - Names of contacts
  - Exposure locations
  - Current medical factors (e.g., initiation of treatment and drug susceptibility results)

Preinterview Phase

- Collect patient background information and circumstances of illness
  - Possible sources include
    - Medical record
    - Reporting physician
- Match patient's name to prior TB registries and the surveillance database

Data to Collect in Preinterview Phase (1)

- History of previous TB exposure or infection
- History of previous TB disease and treatment
- Anatomical sites of TB disease
- Symptoms of illness
- Date of onset
- Chest radiography results
- Other diagnostic imaging study results

Data to Collect in Preinterview Phase (2)

- Histologic or bacteriologic analysis results
- Current bacteriologic results
- Anti-TB chemotherapy regimen
- HIV testing results
- Patient's concurrent medical conditions
- Other diagnoses that may influence or impinge on the interview
- Identifying demographic information

Determining the Infectious Period

- Focuses investigation on contacts most likely to be at risk for infection
- Sets time frame for testing contacts
- Information to assist with determining infectious period
  - Approximate dates TB symptoms were noticed
  - Bacteriologic results
  - Extent of disease

Start of Infectious Period

- Cannot be determined with precision; estimation is necessary
- Start is 3 months before TB diagnosis (recommended)
- Earlier start should be used in certain circumstances (e.g., patient aware of illness for longer period of time)

Estimating the Beginning of the Infectious Period

Characteristic of Index Case			
TB symptoms	AFB sputum smear positive	Cavitary chest radiograph	Likely period of infectiousness
Yes	No	No	3 months before symptom onset or 1st positive finding consistent with TB disease, whichever is longer
Yes	Yes	Yes	3 months before symptom onset or 1st positive finding consistent with TB disease, whichever is longer
No	No	No	4 weeks before date of suspected diagnosis
No	Yes	Yes	3 months before positive finding consistent with TB

SOURCE: California Department of Health Services Tuberculosis Control Branch; California Tuberculosis Controllers Association. Contact Investigation Guidelines. Berkley, CA: California Department of Health Services; 1998.

Closing the Infectious Period

Infectious period closed when all the following criteria are met

- Effective treatment for ≥2 weeks,
- Diminished symptoms, and
- Bacteriologic response

Exposure Period for Contacts

Determined by how much time the contact spent with the index patient during the infectious period

Contact Investigation Interviews

- Establishing trust and rapport with patient is critical
- Interviewers should be trained in interview methods and tutored on the job
- Conducted in patient's primary language or in conjunction with a trained interpreter
- Interviews should be conducted in person in the hospital, TB clinic, patient's home, or a convenient location that accommodates the patients privacy

Interviewing the Index Patient

- Minimum of two interviews should be conducted
  - First interview should be conducted
    - ≤1business day of reporting for infectious patients
    - ≤3 business days for others
  - Second interview conducted 1–2 weeks later
- Additional interviews depend on the amount of information needed and time to develop rapport with patient

Contact Investigation Interview General Principles

- Establish rapport with patient
- Exchange information
- Review transmission settings
- Record sites of transmission
- Compile list of contacts
- Provide closure
- Conduct follow-up interviews, if needed

Proxy Interviews

- Can build on the information provided by index patient
- Essential when patient cannot be interviewed
- Conducted with key informants most likely to know the patients' practices, habits, and behaviors
- Jeopardizes patient confidentiality

Field Investigation (Site Visits)

- Site visits are complementary to interviewing
- Should be made ≤3 days of the initial interview
- Elicits additional contact information; especially helpful for finding children
- Lack of site visits has contributed to TB outbreaks

Follow-up Steps

- Continuing investigation is shaped by reassessments of ongoing results
- Notification and follow-up communication with other jurisdictions should be arranged for out-of-area contacts

Specific Investigation Plan

- Investigation plan should include
  - Information gathered in interviews and site visits
  - Registry of contacts and their assigned priorities
  - Written timeline for monitoring the investigation progress
  - Data recorded on standardized forms
- Part of the permanent medical record

Time Frames for Initial Follow-up of Contacts Exposed to TB

Type of Contact	Business days from listing of a contact to initial encounter*	Business days from initial encounter to completion of medical evaluation†
High priority contact: index case AFB sputum smear positive or cavitary disease on chest x-ray	7	5
High priority contact: index case AFB sputum smear negative§	7	10
Medium priority contact: regardless of AFB sputum smear or culture result	14	10

*A face-to-face meeting that allows the health care worker to assess the overall health of the contact, administer a TST, and schedule further evaluation.

†The medical evaluation is complete when the contact's status (LTBI or TB disease) is determined.

§Abnormal chest x-ray consistent with TB disease, might be NAA positive and /or AFB culture positive

SOURCE: California Department of Health Services Tuberculosis Control Branch; California Tuberculosis Controllers Association. Contact Investigation Guidelines. Berkley, CA: California Department of Health Services; 1998.

Assigning Priorities to Contacts

Assigning Priorities to Contacts (1)

- Priorities should be assigned to contacts and resources allocated to complete all investigative steps for high- and medium-priority contacts.
- Any contact not classified as high or medium priority is assigned a low priority.

Assigning Priorities to Contacts (2)

- Priorities based on likelihood of infection and hazards to the contact if infected
- Priority scheme directs resources to contacts who
  - Have secondary case of TB disease
  - Have recent *M. tuberculosis* infection (most likely to benefit from treatment)
  - Are most likely to develop TB disease if infected or could suffer severe morbidity if they develop TB disease

Factors for Assigning Contact Priorities

- Characteristics of the index patient
- Characteristics of contacts
- Age
- Immune status
- Other medical conditions
- Exposure

Prioritization of Contacts (1)

Patient has pulmonary, laryngeal, or pleural TB with cavitary lesion on chest radiograph or is AFB sputum smear positive

Household contact	High
Contact <5 years of age	High
Contact with medical risk factor (HIV or other medical risk factor)	High
Contact with exposure during medical procedure (bronchoscopy, sputum induction, or autopsy)	High
Contact in a congregate setting	High
Contact exceeds duration/environment limits (limits per unit time established by the health department for high-priority contacts)	High
Contact is ≥ 5 years and ≤ 15 years of age	Medium
Contact exceeds duration/environment limits (limits per unit time established by the health department for medium-priority contacts)	Medium

Any contact not classified as high or medium priority is assigned a low priority.

Prioritization of Contacts (2)

Patient is a suspect or has confirmed pulmonary/pleural TB – AFB smear negative, abnormal chest radiograph consistent with TB disease, may be NAA and/or culture positive

Contact <5 years of age	High
Contact with medical risk factor (e.g., HIV)	High
Contact with exposure during medical procedure (bronchoscopy, sputum induction, or autopsy)	High
Household contact	Medium
Contact exposed in congregate setting	Medium
Contact exceeds duration/environment limits (limits per unit time established by the local TB control program)	Medium

Any contact not classified as high or medium priority is assigned a low priority.

Prioritization of Contacts (3)

Patient is a suspect pulmonary TB case – AFB smear negative, NAA negative/culture negative, abnormal chest radiograph not consistent with TB disease

Household contact	Medium
Contact <5 years of age	Medium
Contact with medical risk factor (e.g., HIV infection or other immunocompromising condition)	Medium
Contact with exposure during medical procedure (bronchoscopy, sputum induction, or autopsy)	Medium

Any contact not classified as high or medium priority is assigned a low priority.

Diagnostic and Public Health Evaluation of Contacts

Initial Assessment of Contacts

- Should be accomplished within 3 working days of the contact having been listed in the investigation
- Gathers background health information
- Permits face-to-face assessment of person's health

Information to Collect During Initial Assessment (1)

- Previous *M. tuberculosis* infection or disease and related treatment
- Contact's verbal report and documentation of previous TST results
- Current symptoms of TB illness

Information to Collect During Initial Assessment (2)

- Medical conditions making TB disease more likely
- Mental health disorders
- Type, duration, and intensity of TB exposure
- Sociodemographic factors

Information to Collect During Initial Assessment (3)

- HIV status; contacts should be offered HIV counseling and testing if status unknown
- Information regarding social, emotional, and practical matters that might hinder participation

Reassess Strategy After Initial Information Collected

After initial information collected

- Priority assignments should be reassessed
- Medical plan for diagnostic tests and possible treatment can be formulated for high- and medium-priority contacts

Tuberculin Skin Testing

- All high or medium priority contacts who do not have a documented previous positive tuberculin skin test (TST) or previous TB disease should receive a TST at the initial encounter.
- If not possible, TST should be administered
  - ≤7 working days of listing high-priority contacts
  - ≤14 days of listing medium-priority contacts

Interpreting Skin Test Reaction

- ≥5 mm induration is positive for any contact
- Two-step procedure should not be used for testing contacts
- A contact whose second TST is positive after initial negative result should be classified as recently infected

Postexposure Tuberculin Skin Testing

- Window period is 8–10 weeks after exposure ends
- Contacts who have a positive result after a previous negative result are said to have had a change in tuberculin status from negative to positive

Medical Evaluation

All contacts whose skin test reaction induration is ≥5 mm or who report any symptoms consistent with TB disease should undergo further examination and testing for TB

Evaluation and Follow-up of Children <5 Years of Age

- Always assigned a high priority as contacts
- Should receive full diagnostic medical evaluation, including a chest radiograph
- If TST ≤5 mm of induration and last exposure <8 weeks, LTBI treatment recommended (after TB disease excluded)
- Second TST 8–10 weeks after exposure; decision to treat is reconsidered
  - Negative TST – treatment discontinued
  - Positive TST – treatment continued

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Evaluation and Follow-up of Immunosuppressed Contacts

- Should receive full diagnostic medical evaluation, including a chest radiograph
- If TST negative ≥8 weeks after end of exposure, full course of treatment for LTBI recommended (after TB disease is excluded)

Medical Treatment for Contacts with LTBI

Health Department Responsibilities

- Focusing resources on contacts in most need of treatment
- Monitoring treatment, including that of contacts who receive care outside the health department
- Providing directly observed therapy (DOT), incentives, and enablers

Window-Period Prophylaxis

Decision to treat contacts with a negative skin test result should take the following factors into consideration

- The frequency, duration, and intensity of exposure
- Corroborative evidence of transmission from the index patient

Prophylactic Treatment

Prophylactic treatment (after TB disease is excluded) of presumed *M. tuberculosis* infection recommended for persons

- With HIV infection
- Taking immunosuppressive therapy for organ transplant
- Taking anti-tumor necrosis factor alpha (TNF-α) agents

Treatment After Exposure to Drug-Resistant TB

- Consultation with physician with MDR expertise recommended for selecting a LTBI regimen
- Contacts should be monitored for 2 years after exposure

Selecting Contacts for Directly Observed Therapy

- Contacts aged <5 years
- Contacts who are HIV infected or otherwise substantially immunocompromised
- Contacts with a change in their tuberculin skin test status from negative to positive
- Contacts who might not complete treatment because of social or behavior impediments

When to Expand a Contact Investigation

Determining When to Expand a Contact Investigation

Consideration of the following factors recommended

- Achievement of program objectives with high- and medium-priority contacts
- Extent of recent transmission
  - Unexpectedly large rate of infection or TB disease in high-priority contacts
  - Evidence of second-generation transmission
  - TB disease in any contacts who had been assigned low priority
  - Infection in any contacts aged <5 years
  - Contacts with change in skin test status from negative to positive

Strategy for Expanding a Contact Investigation

- Should be based on the investigation data
- Results should be reviewed weekly
- In absence of recent transmission, investigation should not be expanded to lower-priority groups

Communicating Through the News Media

Possible Situations for News Coverage

Certain contact investigations have the potential for sensational news coverage. Examples include

- Involving numerous contacts (especially children)
- Occurring in public settings
- Occurring in workplaces
- Associated with TB fatalities
- Associated with drug-resistant TB

Reasons for Participating in News Media Coverage (1)

- Educates the public regarding the nature of TB
- Reminds public of continued presence of TB
- Provides a complementary method to alert exposed contacts of the need for seeking medical evaluation
- Relieves unfounded public fears regarding TB

Reasons for Participating in News Media Coverage (2)

- Illustrates the health department's leadership in communicable disease control
- Ensures that constructive public inquiries are directed to the health department
- Validates the need for public resources to be directed to disease control

Potential Drawbacks to News Coverage

- Increase public anxiety
- Cause unexposed person seeking unnecessary medical care
- Contribute to unfavorable views of the health department
- Contribute to spread of misinformation
- Trigger unconstructive public inquiries
- Unintended disclosure of confidential information

Strategy for News Coverage

- Anticipatory preparation of clear media messages is recommended
- Develop communication objectives
- Issue news release in advance of any other media coverage
- Collaborate with partners outside of the health department

Data Management and Evaluation of Contact Investigations

Data Collection

Three broad purposes in contact investigations

- Management of care and follow-up index patients and contacts
- Epidemiologic analysis of investigation in progress and investigations overall
- Program evaluation using performance indicators that reflect performance objectives

Reasons Contact Investigation Data are Needed

- Presents broad amount of demographic, epidemiologic, historic, and medical information needed to provide comprehensive care
- Provides information on process steps necessary for monitoring timeline objectives
- Provides information needed to reassess investigation strategy

Confidentiality and Consent in Contact Investigations

Safeguarding Confidentiality

- Challenging and difficult during contact investigations
- Essential to maintaining credibility and trust
- Constant attention required to maintain confidentiality
- Specific policies for release of confidential information related to contact investigations are recommended

Confidentiality and Consent

TB control programs should address the following confidentiality and consent issues before initiation of contact investigations

- Contact investigation policies and training
- Informed consent
- Site investigations
- Other medical conditions besides TB

Staffing and Training for Contact Investigations

Staffing and Training for Contact Investigations

- Contact investigations involve personnel in the health department and other health care delivery systems
- Contact investigation tasks require multiple functions and skills
- Training is essential for successful contact investigations

Contact Investigations in Special Circumstances

Definition of an Outbreak

- During (and because of) a contact investigation, 2 or more contacts are found to have active TB, regardless of their assigned priority; or
- Any 2 or more cases occurring within a year of each other, discovered to be linked, and the linkage is established outside of a contact investigation

TB Outbreaks

A TB outbreak is a sign of extensive transmission and implies that

- A TB patient was contagious
- Contacts were exposed for a substantial period of time
- The interval since exposure has been sufficient for infection to progress to disease (interval may be shortened by HIV infection)

Develop Outbreak Strategy Based on Risk Factors

- Contagious TB undiagnosed or untreated for an extended period, or an extremely contagious case
- Source patient visiting multiple sites
- Patient and contacts in close or prolonged company
- Environment promoting transmission
- Contacts very susceptible to disease after *M. tuberculosis* infection
- Gaps in contact investigations and follow-up
- Extra-virulent strain of *M.tuberculosis*

Congregate Settings

Concerns associated with congregate settings

- Substantial number of contacts
- Incomplete information regarding contact names and locations
- Incomplete data for determining priorities
- Difficulty in maintaining confidentiality
- Collaboration with officials and administrators who are unfamiliar with TB
- Legal implications
- Media coverage

Congregate Settings – Designating Priorities

- Site specific
- Customized algorithm required for each situation
  - Source-case characteristics
  - Duration and proximity of exposure
  - Environmental factors that modify transmission
  - Susceptibility of contacts

Congregate Settings - Setting-Based Investigation

- Interview and test contacts on site is optimum approach
- Alternative is evaluation at the health department with additional personnel and extended hours
- As last resort, notify contacts in writing to seek diagnostic evaluation with their own health care provider

Correctional Facilities

- Establish preexisting formal collaboration between correctional and public health officials
- Trace high-priority contacts who are transferred, released, or paroled before medical evaluation for TB
- Low completion rate is anticipated unless follow-through supervision can be arranged for released or paroled inmates

Workplaces

- Duration and proximity of exposure can be greater than for other settings
- Details to gather from index patient during initial interview include
  - Employment hours
  - Working conditions
  - Workplace contacts
- Occasional customers of workplace should be designated as low priority

Hospitals and Other Health-Care Settings

- Personnel collaborating with hospitals and other health-care agencies should have knowledge of legal requirements
- Plan investigation jointly with health department and setting (division of responsibilities)
- Majority of health-care settings have policies for testing employees for *M. tuberculosis* infection

Schools

- Early collaboration with school officials and community members is recommended
- Issues of consent, assent, and disclosure of information more complex for minors
- Site visits should be conducted to check indoor spaces, observe general conditions, and interview maintenance personnel regarding ventilation

Shelters and Other Settings Providing Services for Homeless Persons

- Challenges include
  - Locating the patient and contacts if mobile
  - Episodic incarceration
  - Migration from one jurisdiction to another
  - Psychiatric illnesses
  - Preexisting medical conditions
- Site visits and interviews are crucial
- Work with setting administrators to offer onsite supervised intermittent treatment

Interjurisdictional Contact Investigations

- Requires joint strategies for finding contacts, having them evaluated, treating infected contacts, and gathering data
- Health department that counts index patient is responsible for leading the investigation and notifying health departments in other jurisdictions

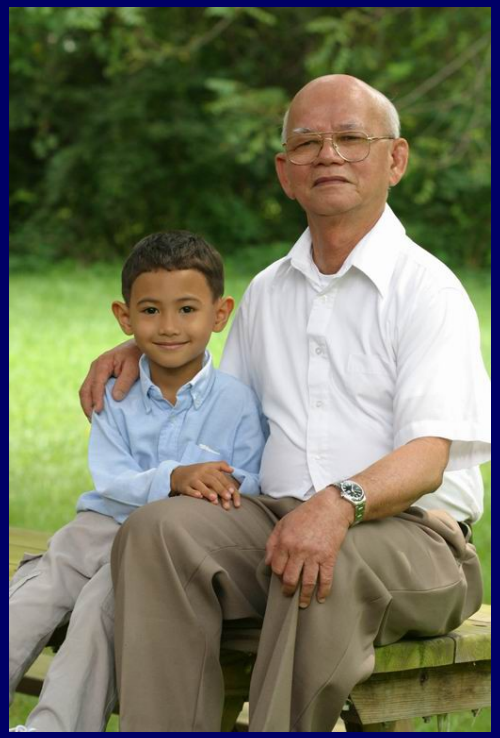
Source-Case Investigations

Source-Case Investigations

- Seeks the source of recent *M.tuberculosis* infection
- In the absence of cavitary disease, young children usually do not transmit *M.tuberculosis* to others
- Recommended only when TB control program is achieving its objectives when investigating infectious cases

Child with TB Disease

- Source-case investigations considered for children <5 years of age
- May be started before diagnosis of TB confirmed



Child with LTBI

- Search for source of infection for child is unlikely to be productive
- Recommended only with infected children <2 years of age, and only if data are monitored to determine the value of the investigation

Procedures for Source-Case Investigation

- Same procedure as standard contact investigation
- Patient or guardians best informants (associates)
- Focus on associates who have symptoms of TB disease
- Should begin with closest associates

Data collection

Data needed for assessing the productivity of source-case investigations

- Number of index patients investigated for their sources
- Number of associates screened for TB disease
- Number of times a source is found

Cultural Competency and Social Network Analysis

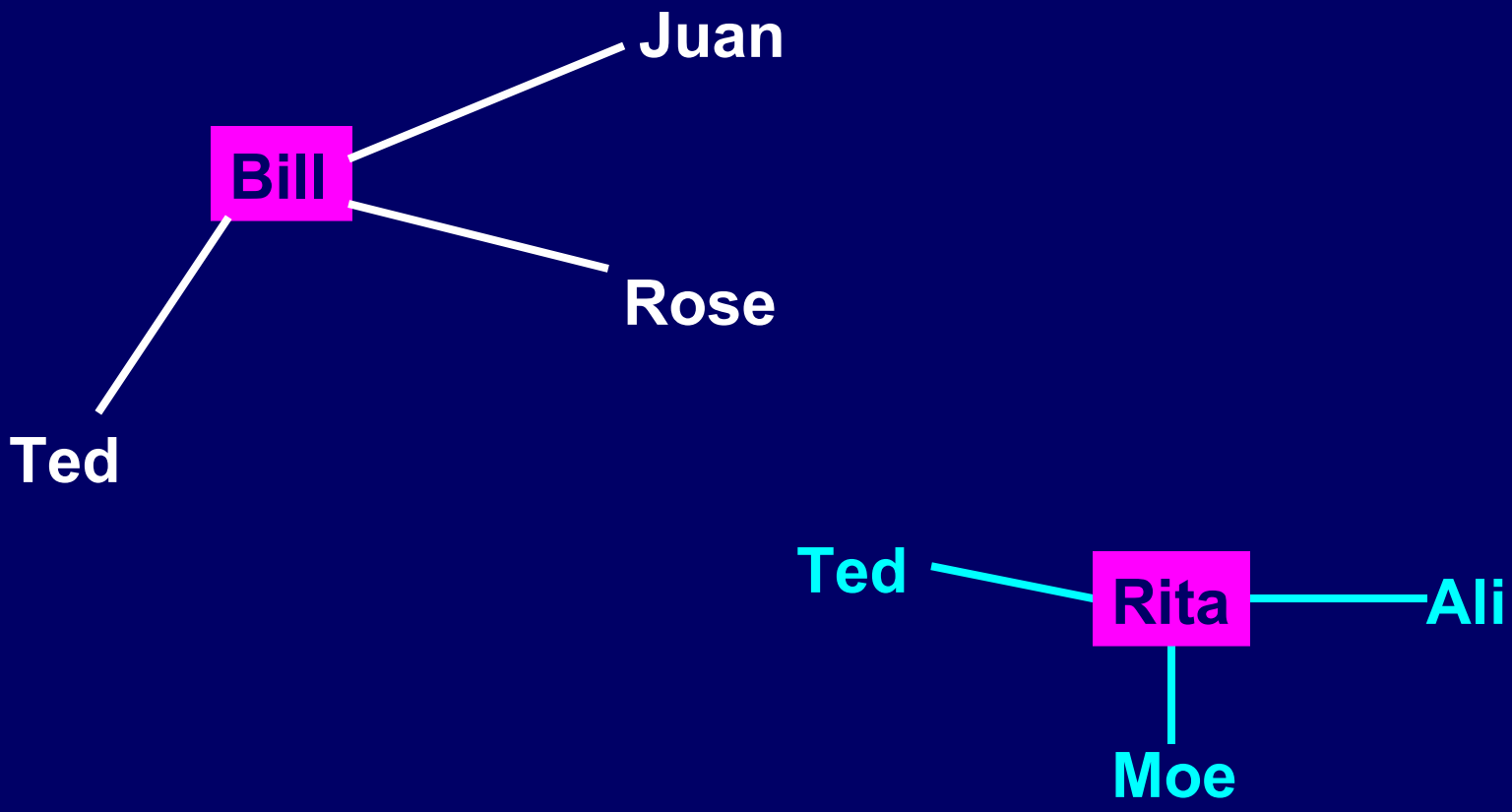
Cultural Competence

- Knowledge and interpersonal skills that allow health-care providers to appreciate and work with persons from cultures other than their own
- Ability to understand cultural norms and to bridge gaps requires training and experience

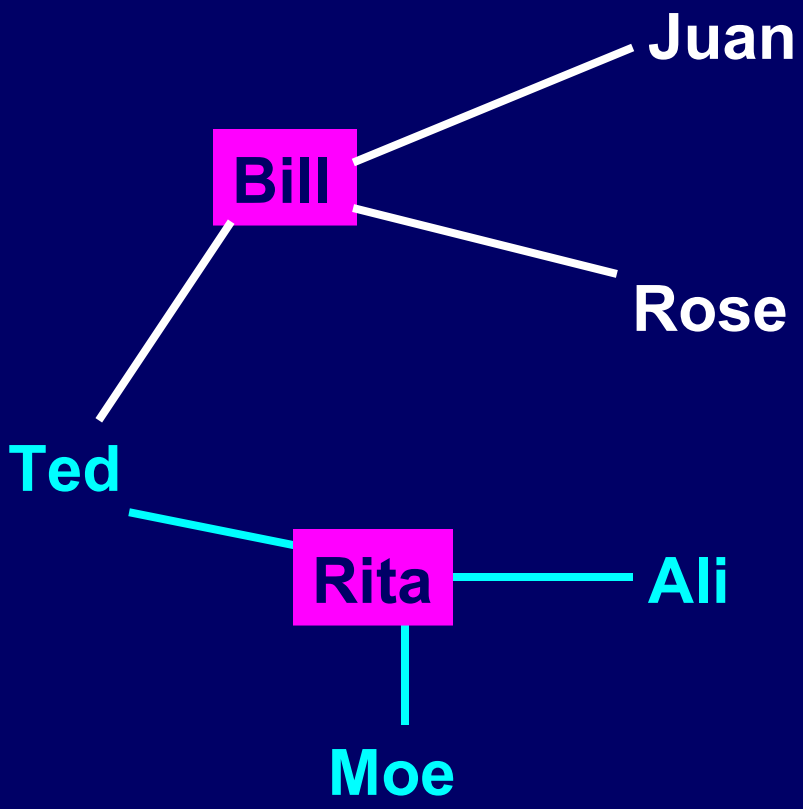
Social Network Analysis

- Social Network – linkage of persons and places where *M. tuberculosis* is spread via shared air space
- Social Network Analysis – methodology of visualizing and quantitating the relative importance of members in a social network
- Social Network Analysis assumes there is some detectable patterning of the TB cases and their contacts in a community

Personal Networks for Two TB Cases

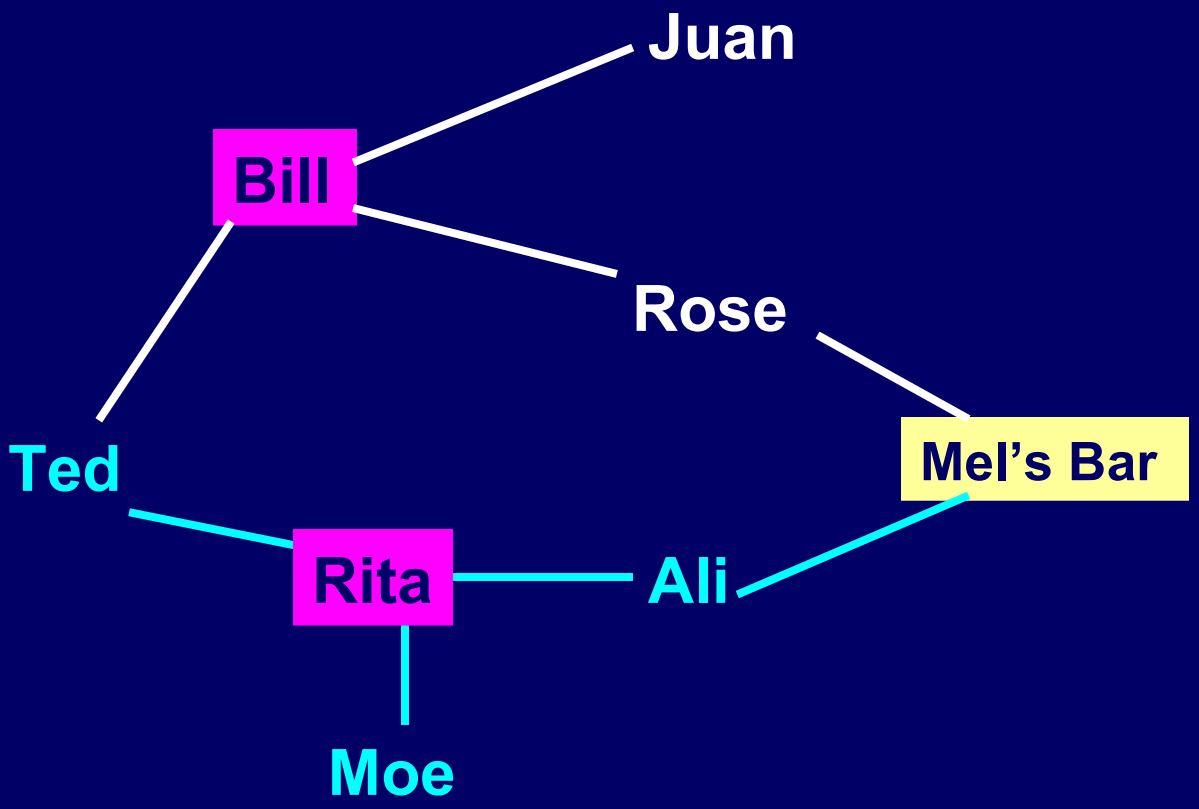


Combined: A Social Network



Allows review of multiple rather than individual personal networks

Combined: A Social Network with Place



Social Network Analysis – Approach (1)

- Provides a systematic method to deal with data already gathered in routine contact investigations
- Analysis of the network can help identify important contacts (i.e., those most likely to be infected)
- Real-time monitoring of network growth may facilitate early detection of outbreaks

Social Network Analysis – Approach (2)

- May help programs focus control efforts
- May offer effective way to list contacts and assign priorities
- Has been tested retrospectively on TB outbreak and contact investigations

Reference

Guidelines for the Investigation of Contacts of Persons with Infectious Tuberculosis: Recommendations from the National Tuberculosis Controllers Association and CDC. *MMWR* 2005; 54 (No. RR–15)

http://www.cdc.gov/mmwr/pdf/rr/rr5415.pdf

Continuing Education Credits (1)

- Participants will be able to receive one of the following
  - Continuing Medical Education (CME) credit – 2.75 hours
  - Continuing Nursing Education (CNE) credit – 3.2 hours
  - Continuing Education Unit (CEU) – 0.25 hours
  - Certified Health Education Specialist (CHES) credit – 2.5 hours
- Participants are required to read and study the guidelines, take a test, and complete an evaluation.

Continuing Education Credits (2)

- MMWR CE Credit
  http://www.cdc.gov/mmwr/cme/conted.html
- Continuing education credits will be available until December 16, 2008

Additional Resources

For additional information on TB, visit the CDC Division of Tuberculosis Elimination Website at http://www.cdc.gov/tb

Guidelines Available Online

CDC's Morbidity and Mortality Weekly Report - http://www.cdc.gov/mmwr