Preventable Tuberculosis Cases Arising from Contacts to Pulmonary Cases in New York City

Holly Anger, Douglas Proops, Tiffany Harris, Shama Ahuja
New York City Department of Health and Mental Hygiene

Rationale: Contacts to infectious tuberculosis (TB) patients are at high risk for TB disease. Contact screening for identification of latent TB infection (LTBI) and treatment of LTBI (TLTBI) are key components of TB control; however, little data exist regarding the longitudinal impact of these interventions within a TB control program setting.

Methods: Using surveillance data, we identified TB cases arising from contacts with a positive tuberculin skin test (TST) result performed as part of contact investigation to 5144 pulmonary TB patients diagnosed in New York City (NYC), 1997—2003. We defined an incident TB case as a contact diagnosed with active TB at least 8 weeks after testing TST-positive through 12/31/2007. We calculated TB incidence rates (IRs) stratified by TLTBI completion. To estimate the proportion of cases that may have been prevented by TLTBI, we calculated the attributable risk percent for TLTBI initiation and completion. We estimated the number of cases prevented by TLTBI by comparing the observed number of incident cases to the expected number that would have occurred had no contacts started TLTBI.

Results: A TST was performed for 25,364 /29,769 (85%) contacts and 7941 (27%) were TST-positive. After excluding 185 contacts diagnosed with active TB within 56 days of the positive result, incident TB occurred in 81/7756 (IR=140/100,000) contacts, including 40/1662 (IR=334/100,000) who never started TLTBI, 20/2195 (IR=119/100,000) who started but did not complete TLTBI, 19/3754 (IR=68/100,000) who completed TLTBI, and 2/145 (IR=187/100,000) who discontinued TLTBI due to adverse reactions.

The TLTBI initiation rate was 79% and of those initiating, 62% completed. Preventable cases occurred in 29/40 (72%) cases who never initiated TLTBI and 8/20 (41%) cases who started but did not complete TLTBI. If none of the TST-positive contacts had started TLTBI, the expected number of TB cases would be 187, leading to an estimated 106 cases that were prevented among NYC contacts.

Conclusions: A large proportion of TB cases arising from infected contacts to NYC TB cases may have been prevented with TLTBI. Even with a low TLTBI completion rate, a substantial number of TB cases were prevented by provision of TLTBI to infected contacts.
ABSTRACT 2

Transmission of *Mycobacterium tuberculosis* from a Cadaver to an Embalmer

Anderson J, O’Flaherty, T, Espinoza R, Proops D  
New York City Department of Health and Mental Hygiene, New York, NY USA

**Background:** The occupational risk of tuberculosis (TB) among funeral services professionals is well documented. We report a case of TB in an embalmer linked through genotyping to a patient who died of TB.

**Methods:** The New York City Health Department performs genotyping on all culture-positive TB isolates using IS6110 restriction fragment length polymorphism and spoligotyping. Cases with matching genotypes are investigated to further characterize possible links. Routine cluster investigation includes patient re-interview and chart review. Additionally, death certificate review and an environmental assessment were conducted.


Isolates from the two patients had matching genotypes. Review of death records revealed that Patient A was embalmed at the funeral home where Patient B worked. Environmental assessment of the funeral home indicated adequate ventilation; however, respirators were not used during embalming. No other epidemiological links were identified between these patients.

**Conclusion:** We demonstrate TB transmission from cadaver to embalmer; without genotyping, this linkage would not be recognized. Infection control practices, including the appropriate use of personal protective equipment, should be adhered to among funeral services professionals since diagnosis of TB at or around death occurs frequently.
ABSTRACT 3

Treatment Acceptance and Completion Rates for Latent Tuberculosis Infection after Implementation of QuantiFERON®-TB Gold, New York City

Kessler JA, Columbia University; and Ahuja SD, Crossa A, and Harris TG, New York City Department of Health and Mental Hygiene

Rationale: Treatment of latent tuberculosis infection (LTBI) among high-risk populations is part of the tuberculosis (TB) control strategy in the United States. Use of the tuberculin skin test (TST) for LTBI diagnosis among individuals who received the Bacille Calmette-Guérin (BCG) vaccine is complicated by cross-reaction of TST antigens with the BCG causing false-positive results which can lead to patient and physician reluctance to initiate LTBI treatment. QuantiFERON®-TB Gold (QFT-G) lacks this cross-reaction. We therefore sought to study the impact of implementing QFT-G testing on LTBI treatment initiation and completion at NYC chest clinics.

Methods: QFT-G results from 10/2006–12/2008 in NYC Bureau of TB Control chest clinics were obtained from the electronic medical record system. The proportions of patients who initiated and completed treatment among patients tested with QFT-G were compared to those tested with TST from 10/2004–9/2006.

Results: Among 38,450 patients tested with QFT-G, 2368 (6%) tested positive, 35,626 (93%) tested negative, and 456 (1%) had an indeterminate result. Among those who tested QFT-G+, 1197 (51%) initiated treatment; of those, 595 (50%) completed treatment. Among LTBI patients, contacts [72%(122/169) vs. 49%(1075/2199) non-contacts] and foreign-born persons [57%(972/1719) vs. 34%(225/664) US-born] were more likely to initiate treatment (both p<0.0001). In multivariate analysis younger age [adjusted odds ratio (adjOR)=0.96, 95% confidence interval (CI)=0.95-0.96], foreign-birth (adjOR=1.87, 95%CI=1.47-2.37), and being a contact (adjOR=2.77, 95%CI=1.91-4.03) were associated with initiation. Among treatment initiators, foreign-born persons [57%(558/972) vs. 36%(81/225);p<0.0001], and contacts [(69% (84/122) vs. 52% (555/1075);p=0.0003] were more likely to complete LTBI treatment. In multivariate analysis these factors remained associated with treatment completion (foreign-birth adjOR=1.92, 95%CI=1.35-2.72, contact adjOR=1.75, 95%CI=1.15-2.67). Historically, among patients tested with TST, 19% (6932/37,713) tested positive; 50% (3500/6932) initiated LTBI treatment and 44% (1545/3500) completed treatment. The proportion of patients initiating LTBI treatment did not differ based on test (p=0.961); however, the proportion completing treatment was higher for those tested with QFT-G (p<0.0001).

Conclusions: QFT-G implementation has greatly reduced the number of persons begun on LTBI treatment and appears to have increased completion. Additional studies are needed to determine whether QFT-G use results in a sustained increase in treatment completion and occurs in settings
other than NYC TB clinics.
ABSTRACT 4

TB PHIMS Reporting and Surveillance: One Year Later

S.Allen, WA State Department of Health, S. Carlson, WA State Department of Health

Objective: To update Washington State Local Health Jurisdictions (LHJs) on the new functions, important reminders, and commonly omitted sections of the TB PHIMS surveillance reporting system since its launch in January 2009.

Method: Two health education consultants and one data specialist developed a 3 hour webinar lecture and discussion. Commonly omitted items in the TB PHIMS reporting systems were reviewed. LHJs were oriented on how to generate, interpret, export and print reports. Of the 39 LHJs, 16 participated in the webinar with a total of 30 participants. There were two webinars provided for LHJs to participate in.

Results & Findings: Evaluations were completed but a rating system was not used. DOH preferred to evaluate the webinar by using questions that required the participants to assist us in determining their needs. Evaluations were all positive and participants felt that it was an important use of their time. A few of the smaller LHJs commented that they hadn’t had a case in 2009 so they had yet to be able to apply what they had learned in the TB PHIMS program. Many LHJs commented that they had learned something they hadn’t known about TB PHIMS. By doing a webinar it was more convenient but took away some of the relationship building you get when visiting for an in-person meeting with the LHJs. Othere comments included: some of the screen shots were hard to see because they had to fit in the small webinar slideshow and some found hard to hear.

Conclusions: LHJs were trained on the new TB tools, which will help their programs be responsible for reporting their own data and be more interactive with DOH staff. It will also help programs obtain national and state timeliness measures, provide more complete and accurate data entry, and develop internal processes. The next steps (if necessary) are to develop a follow-up webinar to explain any functions added to TB PHIMS and areas LHJs have trouble with in 2010.
Where Are They Now? A Comprehensive Approach to Achieving a High Treatment Completion Rate in a Worksite TB Exposure in Washington County, OR

Jennifer R Reuer, MPH1; Trevor Hostetler, RN, BSN1; Sharon Hofer, RN1; Mandy Anderson, BS1; Heidi Behm, RN, MPH2; Paul F Lewis, MD1; Mary Ann Ware, MD3
1Washington County Public Health; 2Oregon Public Health Division; 3Multnomah County Public Health

Washington County is the second largest county in Oregon and sees an average of 17 cases of active TB annually. From October 2006 - March 2007 a worksite TB exposure occurred in a business that experiences high employee turnover. In May 2008, a second clinical case was diagnosed. In total, it was necessary to assess risk and test over 1700 contacts. The majority of this population were young, US born males.

In order to accomplish this task, contacts were prioritized into four risk groups and a comprehensive approach was used to provide testing. This included letters, media advisories, and individual and group outreach by County TB staff to encourage testing for those at risk. Staff also provided screenings at the worksite and followed up with household and social contacts. Additionally, an outreach worker was hired to locate and test high risk people who were no longer employed at the site. Contact was made through phone call, home visits, social networking sites, personalized letters, and text messaging. Materials were developed to facilitate follow-up in the field and track cases and contacts for testing, results, and treatment status. QuantiFERON was used for most testing and rifampin was used to facilitate treatment completion. Worksite or home case management for LTBI was provided to ensure treatment compliance. Incentives were used for all aspects of testing and follow up.

The two highest risk groups included 622 individuals. We tested 79%, of which 21% were positive. Among those who tested positive, 70% completed treatment.

Washington County’s intense investigation and follow up was necessary in reaching this young and highly mobile population. Implementing a comprehensive strategy to educate, locate, test, and treat contacts was vital to achieving a high rate of testing and treatment completion.
A Survey of Inmate Demographics and TB Screening in Oregon Jails: Are our Assumptions Correct?

Heidi Behm, TB Control, HIV/STD/TB, Oregon Department of Human Services; Kathryn Carr, Oregon Health and Science University; Lindsey Lane, TB Control, HIV/STD/TB, Oregon Department of Human Services

Background: A survey was conducted to gain insight on the inmate population found in local jails, TB screening practices and the availability of airborne infection isolation (AII) rooms.

Methods: A 26-question telephone interview of jail medical staff was conducted during July and August 2009.

Results and Findings: Results consisted of responses from 18 jails representing 23 counties. Those surveyed reported a census of 12-1367 inmates with a length of stay of 1-180 days. 56% indicated they held a contract with U.S. Immigration and Customs Enforcement (ICE) to house detainees and 11% house inmates from multiple counties. Reported tuberculosis screening practices varied. 61% of jails indicated medical screening was done by corrections officers. 17% do not ask inmates about TB symptoms and 44% do not ask about TB risk factors during the medical screening. 49% of facilities reported they do not place TB skin tests on a routine basis. 50% do not have an AII room.

Conclusions: Although there is a need to standardize TB screening practices throughout jails to ensure better TB control, differing facility size and inmate populations make this difficult. Previous educational efforts have targeted medical staff but it is correction officers who do the intake medical screening in most of the surveyed facilities. As many local jails have limited capacity to isolate inmates with infectious tuberculosis, there should be an emphasis on transferring inmates with suspected TB out of the facility when there is not an AII room.
How to Survive a Winter of TB in North Dakota

R. Birk, K. Guerard, K. Kruger, R. Gardner, L. Well
North Dakota Department of Health

Background: North Dakota has an average TB case rate of 0.9 per 100,000 people. Between 2004 and 2008, 33 percent of the active TB cases were among foreign-born people. However, 2009 was completely different with 80 percent of the cases occurring among foreign-born people. Another characteristic that makes 2009 different from previous years is that there was an increase in the complexity of the cases. One case of pulmonary TB was co-infected with Mycobacterium avium and later determined to have isoniazid-resistant TB. Another case was diagnosed with a cerebral tuberculoma.

Methods: North Dakota was allocated $94,860 for TB prevention, control and elimination activities in 2009. No state funds are provided specifically for TB activities. TB case management and contact investigations are performed by local public health TB nurses, whose activities are reimbursed on a quarterly basis. The state TB program acts in an advisory capacity to the local TB programs; however, the state does not have a dedicated TB nurse consultant or physician. TB-related laboratory testing is performed free of charge by the state public health laboratory.

Results: In the case of the TB and M. avium co-infection, molecular drug susceptibility testing through the CDC was attempted, but it failed to detect any TB DNA. The state public health lab was eventually able to isolate the TB in a mono-culture, and it was determined to be isoniazid-resistant. The patient is now on an appropriate drug regimen, is clinically improving and is sputum culture-negative for TB. The case of the cerebral tuberculoma was complicated by several adverse reactions to the standard TB drug regimen, such as elevated liver enzymes, rash and kidney failure. Therefore, second-line and experimental drugs had to be used on the patient. The patient has clinically improved and is on an appropriate drug regimen.

Conclusions: When conducting TB prevention, control and elimination activities on a limited budget, innovative practices are necessary. Some strategies North Dakota employed to deal with the complicated cases described above are: 1) know who to call, 2) understand your program’s capabilities, 3) find alternative sources of funding, if possible, 4) prepare for the worst, but hope for the best, 5) sometimes new technology cannot substitute for hard work.
How Community Partners Can Play a Vital Role in TB Education — Working with the Cape Verdan and Ecuadorian Populations in Massachusetts, 2010

Bosso E1; Sharnprapai S2; Etkind S2; DelValle M2
1Centers for Disease Control and Prevention, Scientific Education and Professional Development Program Office (proposed), Public Health Prevention Service, assigned to Jamaica Plain, Massachusetts
2Massachusetts Department of Public Health, Division of Tuberculosis Prevention and Control, Jamaica Plain, Massachusetts

Background: The Community Initiative for TB Education (CITE) was created to increase testing and treatment of latent TB infection (LTBI) among populations at higher risk for TB. In 2008, approximately 216 of 261 (83%) tuberculosis (TB) cases in Massachusetts were among non-U.S.-born persons. When TB clinic data for 2006–2008 were analyzed, increases in LTBI were demonstrated among Cape Verdeans in Brockton and Ecuadorians in Milford (from 27 to 59 and 12 to 16 infections, respectively). To increase testing and treatment of LTBI among these groups, CITE developed partnerships with three community groups and two health centers that serve these populations and identified multiple ways to disseminate TB information.

Methods: CITE identified and partnered with community organizations in the Ecuadorian and Cape Verdan communities. Partners assisted in organizing six focus groups (four with Ecuadorian and Cape Verdan community members and two with healthcare providers) and four key informant interviews (one community leader and one provider from each group). Focus groups assessed the knowledge, attitudes, and beliefs surrounding TB, and that information was used to develop educational tools for communities and providers.

Results: Community partners assisted in recruiting 39 participants for six focus groups. Among Ecuadorians, only 2 of 11 (18.2%) persons had any knowledge of TB or LTBI, whereas all 16 Cape Verdeans (100%) knew what TB was and could name symptoms. Cape Verdeans identified a number of social networks through which information could be disseminated, including local television and radio stations. In contrast, Ecuadorians had no similar networks available; however, focus groups and partners identified local churches and English-as-second-language classes as the sites where TB information could be best disseminated. In the Ecuadorian community, messages focus on basic TB knowledge, whereas Cape Verdan messages focus on testing, treatment, and TB in the community.

Conclusions: Community partners played a key role in identifying and organizing outreach activities that can facilitate testing and treatment of LTBI among these two populations. Although limitations exist with using focus group analyses (i.e., limited sample size and group effect on individual responses), they were vital in identifying networks and key messages.
**ABSTRACT 9**

Benefits of Integrated Testing and Services in Homeless Shelters

*Michelle Allen, Bruce Bradley, Ben Yarn, Veronica Hartwell, Ruby Lewis-Hardy, Brian Palmer*

*Fulton County Department of Health and Wellness*

**Background:** In 2008, Georgia had 478 TB cases, 61,347 STI cases, and 33,599 HIV cases (2007 data for HIV). Fulton County (Atlanta) is one of three metropolitan counties which account for 47% of the state’s TB cases and 33% STI and 50% HIV cases (2007 data for HIV). The Fulton County Department of Health and Wellness Communicable Disease Prevention Branch (CDPB) is an example of clinical program integration comprised of three clinics: Sexually Transmitted Infection (STI), HIV Primary Care, and TB. There is a need to enhance services at local homeless shelters, which may lead to reducing disparities in access to care. The CDPB began integrated testing and services at two area shelters in response to high rates of INH-Resistant TB among shelter residents.

**Methods:** Each staff or resident of the shelters that agreed to be tested were interviewed prior to testing for signs, symptoms, or previous TB disease, and for additional locating information. Those reporting signs or symptoms were evaluated on-site by a physician. All shelter participants were offered testing for TB (QuantiFERON-B Gold [QFT]), HIV, and syphilis. They were also offered additional services: chest x-rays, physician evaluation, and immunizations for Influenza (H1N1), hepatitis A & B, meningitis, and tetanus. CDPB provided incentives and enablers for those that participated.

**Results:** During the screening, 416 residents and shelter staff members were screened for TB, HIV, and syphilis from March 8 – 15, 2010. One hundred thirty four (32%) had a positive QFT: of these, 109 (81%) received a chest x-ray. Three hundred sixty-one (361) were screened for syphilis and HIV: 29 (8%) were HIV-positive and 23 (7%) tested positive for syphilis.

**Conclusion:** Integrating testing for TB, HIV, and syphilis and providing immunizations are achievable in homeless shelters. This integrative strategy should be pursued in other shelters to increase access to care, increase detection of disease, reduce transmission of disease, and reduce disparities.
ABSTRACT 10

Tuberculosis Mortality in a Low-Incidence State

D Richter¹, J. Braun², D. Fortune², D. Isaaks², and M. Burgos¹,².
¹University of New Mexico School of Medicine, Albuquerque, NM
²New Mexico Department of Health Tuberculosis Program, Santa Fe, NM

Purpose: To identify missed opportunities in tuberculosis (TB) prevention, diagnosis, and treatment, and to identify TB mortality risk factors among New Mexico’s tuberculosis population.

Design: We used a retrospective cohort study design to identify the cause of death and any missed opportunities in diagnosis and prevention for patients who died with TB in New Mexico from 2007-2009.

Results: Out of 159 patients diagnosed with TB during the study period, 25 (15.7%) patients who died with confirmed TB were included in the final study group. The average age of the patients was 71.7 years (range 36-92); 14 (56%) of 25 patients were female. Ten (40%) of the patients were Hispanic and another 10 (40%) were Native American. Twelve (48%) of the patients were foreign born, with 10 (40%) having been born in Mexico. Only 10 (40%) of the patients were diagnosed by sputum culture, and only 3 (12%) had a cavitary infiltrate on chest radiograph compared to 6 (24%) who had miliary infiltrates on chest radiograph. Of the 25 patients with confirmed TB, 11 (44%) of the cases were pulmonary disease only, with the remaining 56% of cases being extrapulmonary disease only or both pulmonary and extrapulmonary disease. Eight (32%) of the patients had pulmonary disease (either COPD or pulmonary fibrosis), 7 (28%) of the patients had diabetes mellitus, 3 (12%) of the patients were HIV-seropositive, and 9 (36%) of the patients had hypothyroidism. Seventeen (68%) of the deaths were determined to be due to TB-associated disease. Seventeen (68%) of the patients died during TB therapy, with the remaining 32% of patients dead at TB diagnosis or having died prior to starting TB therapy. The most common missed opportunity for diagnosis and prevention of TB was either a provider delay in diagnosis (60% of cases) or a patient delay in diagnosis (48% of cases).

Conclusion: In this study we confirmed a high tuberculosis-related mortality in a low-incidence state. We identified missed opportunities in diagnosis and prevention that can be used to help reduce future deaths in New Mexico due to tuberculosis.
ABSTRACT

Indiana’s Immigrant TB and All Refugee Application (ITARA) and Minnesota’s Electronic System for Health Assessment of Refugees (eSHARE):
A Case Study in Collaboration

Sarah Burkholder, Indiana State Department of Health

Background: Between 2004-2006, Indiana resettled approximately 400 refugees per year. In 2007, the number increased to 1533. In December 2007, the Indiana State Department of Health (ISDH) hired a full-time Refugee Health Coordinator (RHC) to build a Refugee Health Program (RHP). Calendar year 2008 brought 1552 more primary arrivals to Indiana.

Methods: The Indiana RHC asked the Minnesota RHP for guidance. Minnesota shared its refugee screening form for Indiana to adapt. Also, the Minnesota RHP had recently launched a project to enhance infectious disease surveillance among new refugees within Minnesota with the intention of working with other state RHPs. A part of this project included demonstrating their Electronic System for Health Assessment of Refugees (eSHARE).

Results and findings: In 2008, after an eSHARE demo, a Memorandum of Understanding (MOU) was initiated between the two states to allow Indiana to acquire eSHARE and adapt it for the specific program needs of the ISDH TB/Refugee Health Division. Because eSHARE was developed prior to the introduction of the Electronic Disease Notification (EDN) system, it did not include data collection from the TB follow up worksheets for refugees and immigrants who enter the United States with a TB Classification. Indiana modified eSHARE to include TB follow up worksheet data and renamed its version the Immigrant TB and All Refugee Application (ITARA). The system moved to production in December 2008.

Conclusions: Texas and Illinois have also adopted eSHARE. Minnesota developed procedures for sharing eSHARE updates and upgrades between State Refugee Health Programs.

D.A.Corimanya, MD, MPH, Sedgwick County Health Department,  
P.E.Griffin, BBA, CPM, Kansas Department of Health and Environment,  
E. Ablah, PhD, MPH, The University of Kansas, School of Medicine-Wichita,  
D.B. Fromer, MT (ASCP), MPH, Sedgwick County Health Department,  
A. Paschal, PhD, MEd, The University of Kansas, School of Medicine-Wichita

Background and Objectives: In the U.S., foreign-born individuals and racial/ethnic minorities continue to bear a disproportionate burden of tuberculosis (TB) disease. The national proportion of TB cases occurring in foreign-born persons has been increasing since 1993. The objective was to answer three questions: (1) the demographic attributes of those foreign-born and U.S.-born Kansans diagnosed with active TB disease between 2004 and 2008; (2) the factors associated with this disease among foreign-born and U.S.-born Kansans diagnosed with active TB disease; and (3) the immigration time frame. Specifically, how much time passed between the individual’s first arrival in the U.S. and the positive TB diagnosis.

Methods: Data on patients reported to have active TB disease in Kansas from 2004 to 2008 were obtained. Frequencies, cross-tabulations, and non-parametric tests were used to analyze the dataset. Unknown responses were excluded from analysis. For all analysis p<0.05 was considered significant.

Results: From 2004 through 2008, 320 TB cases were reported: 128 (40%) TB cases in U.S. persons and 192 (60%) TB cases in foreign-born persons. Foreign-born persons had greater TB rates (24.5/100,000) compared with U.S.-born persons (1/100,000) in Kansas. While the Kansas TB rate is lower than the nationwide TB rate, the TB rate among foreign-born persons in Kansas is higher than the nationwide rate (21.7/100,000). U.S.-born TB cases were more likely than foreign-born TB cases to have reported alcohol abuse (p <0.05), injection drug use (p<0.05), non-injection drug use (p<0.05) and homelessness (p < 0.05). The majority of the foreign-born TB cases were diagnosed within five years or less of residing in the United States (n=103, 53.6%), compared with those who were diagnosed within two years or less of residing in the United States (n=76, 39.6%).

Conclusions: The Kansas TB situation is not unlike the nationwide situation. The increasing disparity between U.S.-born and foreign-born persons regarding TB disease in Kansas must be addressed if the U.S. is to reach the goal of TB elimination.
ABSTRACT 13

Applying Molecular Drug Susceptibility Testing and IS6110 Restriction Fragment Length Polymorphism to aide in the treatment of a Pediatric *M. tuberculosis* Case

Erick Cortes, MPH, NJ Department of Health & Senior Services; Karen Galanowsky, RN, MPH, NJ Department of Health & Senior Services; Natalia Kurepina, PhD, Public Health Research Institute; Barry Kreiswirth, PhD, Public Health Research Institute

Background: New Jersey Department of Health & Senior Services partnered with the Public Health Research Institute, to make molecular testing available to public health tuberculosis (TB) clinics throughout New Jersey. In November 2009, a TB nurse case manager found a, non reported, highly infectious Asian male diagnosed with pulmonary TB; two months prior in another state. The resulting contact investigation yielded his eight month old child with TB. An immediate search for initial culture results found the specimen at an out-of-state laboratory.

Methods: For fast sequencing of mycobacterial genes conferring drug resistance, *M. tuberculosis* bacteria grown on LJ slant were collected, heat-killed at 80°C for 20 min and boiled in lysis buffer for 10 min. PCR-amplified fragments of genes rpoB, katG, inhA, gyrA, rpsL and pncA were sequenced and compared to H37Rv complete genome (http://genolist.pasteur.fr/TubercuList/index.html) for identification of mutations leading to drug resistance. For RFLP analysis total chromosomal DNA was isolated according to the protocol, digested with PvuII restriction endonuclease and hybridized with IS6110-specific probe after transfer to nylon membrane. RFPL image was compared to the image library using BioImage software and assigned to strain family

Results: Molecular drug susceptibility testing based on the DNA sequencing of target genes showed evidence of mutations in genes rpoB (S531L), katG (S315T), and gyrA (D94G). These mutations signify resistance to rifampin, isoniazid, and quinolones, respectively. Results were generated 5 days after slant submission to PHRI. Direct DST results confirmed the molecular resistance pattern four weeks later.
DNA Sequencing to Detect Cases of Drug Resistant Tuberculosis

Jennifer R. Crew¹, Ira Heimler¹, Ahmad Abu-Arqoub¹, Michael Arbise², and John Nawrocki³
¹Illinois Department of Public Health, Chicago, ²Illinois Department of Public Health, Springfield

Global eradication of tuberculosis has been undermined by drug resistant strains of *M. tuberculosis* (MDR-TB). We have instituted an algorithm for rapid detection of such infections from sputum specimens by a PCR-based DNA sequencing assay. Early information about resistance could lead to more effective treatments, allowing for better case outcome, lessening the chances of transmission, and deterring the development of additional drug resistance.

We prepare DNA from processed sputum sediments by lysis. This DNA is used to prepare templates from regions of the genome implicated in drug resistance. The templates are assayed by cycle sequencing, aligned with the normal gene, and genetic changes implicated in drug resistance are noted. Resistance is confirmed by traditional phenotypic analysis.

During our validation study, we correctly identified resistance or sensitivity in specimens with as follows: 98.8 percent for rifampin (n=80), 98.6 for isoniazid (n=70), 94.4 for pyrazinamide (n=79), and 90.4% for ethambutol (n=52). Because DNA sequence analysis is labor intensive and expensive, during a year-long prospectus study we plan to limit analysis to specimens that are both acid-fast positive by smear analysis and positive for the *M. tuberculosis* complex by an additional PCR test, as well as meeting one of the following criteria:

- At least 60 days since the last resistance testing and the patient is not responding
- High-risk of MDR-TB
- High profile patients or index cases in an outbreak
- Patient has an adverse reaction to treatment
- Specimen is a mixed culture or is phenotypically indeterminate

In conclusion, we are able to determine drug resistance from sputum specimens within one week of submission, giving clinicians important information needed to design effective treatment programs. This algorithm is also useful for monitoring individuals for conversion to MDR status during treatment, as well as for mixed cultures and specimens that can otherwise not be phenotyped.
A Statistical Method to Prioritize *M. tuberculosis* Genotype Clusters for Tuberculosis Control Programs’ Use in the United States

Kammerer JS (Northrup Grummond, GA), Chatterjee SG (DTBE, CDC, GA), Moonan PK (DTBE, CDC, GA), Miramontes R (DTBE, CDC, GA), Cronin WA (MD Dept of Health and Mental Hygiene), Navin TR (DTBE, CDC, GA), and the Tuberculosis Epidemiologic Studies Consortium (USA)

Background: Since 2004, CDC has provided molecular characterization (genotyping) of *M. tuberculosis* isolates from culture-positive tuberculosis (TB) patients in the U.S., and recommended routine investigation of transmission events. However, due to limited resources, most TB control programs are unable to conduct investigations for all events, and it is unclear how to prioritize these events to most effectively reduce on-going transmission.

Purpose: To describe a statistical method that predicts recent TB transmission using national molecular surveillance data.

Methods: A statistic using a modified log-likelihood ratio (LLR) was developed using routinely collected surveillance information. The LLR uses 3 years of data to measure a county-based geospatial concentration of a specific genotype compared with the average concentration in the rest of the U.S. The calculated LLR statistic was used to assign genotype clusters into high-, medium-, and low-priority for investigation. The assigned cluster priorities were compared to: expert opinion, a SaTScan spatial scan statistic software analysis, and known outbreaks investigated by CDC.

Results: On comparison, the county-based LLR was similar to SaTScan in identifying high- vs. low-priority TB clusters. For clusters ranked independently by local public health experts, the median LLR values were 10.7, 3.5, and 0.6 for high, medium, and low priority clusters, respectively. Among 9 outbreaks investigated by CDC, all clusters had a high priority assignment based on LLRs of 11 or higher.

Conclusions: Although the LLR statistic holds promise, more rigorous field testing and validation of the LLR is needed. To understand the utility of the LLR statistic for widespread use and to determine true cut-points, a CDC-sponsored study (TBESC Task Order 26) was initiated. Task Order 26 will provide a blinded, systematic evaluation of genotype clusters as a final test of the method, and will also assess whether combining the LLR values with epidemiologic and temporal information will enhance cluster prioritization and response. Validating these methods will enhance integration of TB genotyping into routine TB control.
ABSTRACT 16

Quantiferon-TB Gold In-Tube Assay Results Among Low Risk TST Positives in Mississippi

Thomas Dobbs¹, Paul Byers¹, Mike Holcombe¹, Risa Webb², Brian Temple²
¹Mississippi State Department of Health
²University of Mississippi Medical Center

Background: Interferon gamma release assays (IGRA) have been shown to be more specific than tuberculin skin testing (TST) in identifying latent tuberculosis infection. This is due to the use of antigens more specific to Mycobacterium tuberculosis and not present in most non-tuberculous mycobacteria (NTM) or BCG. NTM’s are widespread in Mississippi and the majority of acid fast bacilli clinical isolates in MS are NTM. The broad use of TST in this low incidence settings may improperly identify individuals as LTBI.

Methods: 56 individuals with no identifiable risk factors for TB, in the county health department clinics in southern Mississippi, were selected. All were TST positive and had subsequent Quantiferon-TB (QFT) Gold In-Tube testing. Correlations between TST and QFT results were assessed and associations analyzed based on TST size, reason for testing and demographic factors.

Results: In this cohort of low risk individuals, TST and QFT correlated poorly. Only 12.5% of patients had positive QFT results. TST readings of >15 mm were more strongly associated with positive QFT results when compared to those with TST <15 (21% and 9% respectively, p=0.025). There were no statistically significant associations identified when comparing age, sex, race or reason for testing.

Conclusions: TST and QFT correlate poorly in this low risk population. Improved diagnostic strategies need to be developed that better identify LTBI infection among low risk individuals in Mississippi.
ABSTRACT 17

Collaborative Effort between TB Control Program and TB Laboratory Leads to Successful Implementation of Quantiferon Gold In-Tube Service

T.L. Elliott, P.E. Griffin, Kansas Department of Health and Environment, Topeka Kansas

Background and Objective: With the introduction of IGRAs, Kansas immediately began to consider the possibilities and impact on TB eliminations efforts in the state. Given that more than two-thirds of cases each were among person born outside of the US and many had contacts who were BCG vaccinated it was determined one area of use for the tests would be contacts. It was also observed that 15 - 20% of cases each year were among international students in our colleges and universities, thus establishing another use for the test. The objective was to establish a Quantiferon Gold In-Tube (QFT) service in a rural state that will meet Public Health best practice needs at an affordable cost to target audience.

Methods: Review of current literature to determine the most important target audiences. Market analysis conducted to determine current service availability and cost as well as realistic access to current services by the target audiences. Target audiences surveyed to establish a demand for the service that is not being met.

Results: The Kansas Public Health TB Laboratory became a validated provider of the QFT service. The Kansas TB Control Program targeted two populations for initial roll out of service, state universities screening high risk incoming students (generally international students with BCG vaccination) and high risk contacts identified in contact investigations statewide. In three years, the program has grown from processing less than two hundred tests in 2008 to an expected two thousand tests in 2010. Laboratory costs are neutral with reimbursement arrangements contracted with submitters. TB Control Program costs are decreased as a resulted of fewer required follow up expenditures for contacts that were BCG vaccinated and previously had questionable screening results.

Conclusions: In Kansas, a successful, cost effective and growing QFT service has been established. Such a service would not have been possible without a willing collaboration of the TB laboratory and TB program.
Innovate to Accelerate: On the Move to Integrate TB Prevention and Control with HIV/AIDS, Viral Hepatitis, and STD Programs at the Philadelphia Department of Public Health (PDPH)

Marcelo Fernandez-Viña, MPH; Caroline Johnson, M; Barry Dickman, MPA; Daniel P. Dohony, MPH; M. Ann Ricksecker, MPH; Debra L. D’Alessandro, MPH.

1Philadelphia Department of Public Health; 2Philadelphia TB Control Program; 3Health Federation of Philadelphia, 4Pennsylvania/MidAtlantic AIDS Education and Training Center, Health Federation of Philadelphia

Background: Program integration is a major area of interest for Tuberculosis, HIV/AIDS, Viral Hepatitis, and STD programs for improving disease control, patient care, and program efficiency. In response to CDC guidance on Program Collaboration and Service Integration (PCSI), the Philadelphia Department of Public Health (PDPH) Division of Disease Control (DDC) started a program integration initiative and workgroup in early 2008. The initial aims of the PDPH PCSI workgroup were to assess the status of integration between programs and understand how this level of integration was achieved. The PDPH TB Control Program played an integral role in this initiative.

Methods: Program integration status was assessed through structured key informant interviews with program staff. Quarterly workgroup meetings are held to discuss program integration, create feasible goals, and report progress and barriers.

Results and Findings: Assessments revealed a high degree of program integration relative to CDC guidance. Action steps and barriers were identified, which facilitated further integration. Through this workgroup the TB Control Program strengthened relationships with other disease program areas, and gained further access to target populations. The TB Clinic expanded their capacity to offer integrated services as a result this local PCSI initiative.

Conclusions: Through establishing a PCSI workgroup at PDPH, infectious disease programs were able to identify opportunities for further program collaboration, improve patient access to services, and create a more efficient system.
The Cohort Review Process in New York State: Pieces of the Puzzle

Colleen Flynn1, Christina Faulkner1, Cheryl Kearns1, Stephen Hughes1, Edwin Rodriguez1,2, Margaret Oxtoby1,2
1 New York State Department of Health, Bureau of Tuberculosis Control Albany, NY
2 Centers for Disease Control and Prevention, Division of Tuberculosis Elimination, Atlanta, GA.

Background: New York State, excluding New York City, includes 57 counties, each with its own local health department (LHD). Three LHDs report >40 cases/year, 4 report 10-30 cases/year, 7 report 3-9 cases/year, and 43 average 0-2 cases/year. For disease surveillance NYS is divided into six regions. NYS looked for strategies to assure accountability which strengthen, rather than compete with, ongoing case management and reporting activities.

Methods: Existing cohort review activities were inventoried including quarterly morbidity update requests from the Data Unit to each LHD to assure timely, complete and accurate surveillance data; quarterly contract reports from the 11 highest morbidity counties detailing progress on key outcome measure; and LHD-based case reviews in 7 counties held at specific intervals (monthly, quarterly or yearly). In 2005 NYS added annual regional cohort reviews. Review criteria include standard TB program objectives and focus on active cases and suspects. Central office staff generate line lists and statistical summaries before the review. Regional staff present cases to the Program Nurse and Assistant Field Supervisor, problematic areas or new program strategies are discussed.

Results: From 2005-2008, the most striking improvement was in HIV testing (66% to 80%); other key parameters, e.g. sputum conversion, completion of treatment within 12 months, have shown little change. Regional staff demonstrate increased familiarity with details of patient care and effective followback with county nurses around case management activities. Additional parameters relating to sentinel events (deaths, pediatric cases, relapsed cases) and contact investigations have been added to the regional reviews.

Conclusion: Cohort reviews must be conducted on cohorts large enough to allow generation of meaningful statistical data, and be presented by persons with responsibility for case management or oversight. For lower morbidity areas, regional reviews have proved a successful complement to other quality assurance activities in NYS.
Knowledge, Attitudes, and Beliefs About TB Testing Among Healthcare Workers who Receive an Interferon-Gamma Release Assay as Part of Routine Employee TB Testing

J. Franks¹, Y. Hirsch-Moverman¹, A. Khan⁰, A. Maiuri⁰, and N. DeLuca²
¹Charles P. Felton National Tuberculosis Center, Columbia University, New York, NY
²Division of Tuberculosis Elimination, Centers for Disease Control and Prevention, Atlanta, GA

Background: The Centers for Disease Control and Prevention recommends tuberculosis (TB) testing of healthcare workers (HCWs) upon hire and periodically thereafter, using either a tuberculin skin test or an interferon-gamma release assay (IGRA). IGRAs are relatively new diagnostic tests for TB infection, and HCWs' KAB about routine testing based on IGRAs are not well understood.

Methods: A focus group guide was developed to elicit participants' KAB about IGRAs, and their preferences for receiving education about TB testing methods for employee health evaluation. HCWs who have received both TST and IGRA for routine employee TB testing were recruited to participate in focus groups. Discussions were recorded with permission from participants. Transcribed data was analyzed using Atlas-ti software.

Results: Forty-six HCWs participated in five focus groups conducted in Colorado, Texas, and Nevada. Themes resulting from the analysis include: low perceived need for testing; inconveniences related to testing method; high expectations and little knowledge regarding effectiveness of IGRAs to detect TB infection; and reservations about the safety of IGRAs. Preferred methods for receiving information about routine TB testing and evaluation in healthcare settings included brief individual education sessions with providers and easily accessible written information.

Conclusions: Results suggest that implementation of IGRAs for serial testing should include education on the rationale for routine TB testing and evaluation of HCWs, as well as information on available TB diagnostic tools.
ABSTRACT 21

Trends in Pediatric Tuberculosis – South Carolina, 1994 – 2007

Margaret Griffith, Eric Brenner, Shea Rabley, and Tammy McKenna
South Department of Health and Environmental Control

Objective: Pediatric TB (PTB) diagnosis, case management, and control measures can be challenging. Additionally the morbidity and mortality associated with PTB demonstrate that young children are vulnerable, even in the US. Given the gravity of this public health issue, an evaluation of PTB trends in South Carolina was performed.

Methods: Using South Carolina’s Report of Verified Case of Tuberculosis data from 1994 to 2007 and US census data, descriptive statistics of the 240 cases of TB among children less than 15 years of age were analyzed.

Results: Incident cases ranged from seven to 26 cases per year, or 0.8 to 3.2 cases per 100,000 children per year. Seventy percent of cases were among children aged 5 years or less. Cases were more likely to be boys, African American, non-Hispanic, and US-born. Fifteen children were foreign-born, five children were homeless, and one reported non-intravenous drug use.

Tuberculin skin tests (TSTs) were positive in 201 (84%) of cases; however, 34 TSTs (14%) measured 0 mm. Of the 24 children (10%) with sputum smears, four and 10 had positive microscopy and cultures, respectively. Fifty cases (20%) were supported with bacterial evidence, of which 35 had susceptibilities assessed. Four of these were drug resistant.

The most common sites of TB disease were intrathoracic lymph nodes (54%), lung (50%), and cervical lymph nodes (10%). Of the 209 abnormal chest roentograms, 201 had noncavitary lesions. The case fatality rate was 0%. HIV testing was offered for 82 HIV(-) children, of whom 23 declined; none of the 59 HIV tests were positive. One child was previously diagnosed with HIV.

Conclusion: The number of cases supports that a decreasing trend has occurred during this period. However, small sample size limited further analysis, including determining if the counts recently have plateaued or changed otherwise. Policies were reviewed to improve health care provider performance, including training at statewide conferences and circulating training materials to the community providers ultimately to improve the community’s and the division’s response to PTB.
ABSTRACT 22

Improving Tuberculosis (TB) Screening Following Known TB Exposure in Large Urban Homeless Shelters: A Pilot Project Utilizing the Homeless Management Information System (HMIS)

L. Haglund, J. Hoskins, S. Millow
Hamilton County TB Control Clinic

Background: The incidence rates of TB in Cincinnati and Hamilton County, Ohio have averaged 7.0 and 3.5 per 100,000 residents, respectively, over the past 18 years. During three separate years, 1990, 1999, and 2007, TB rates have been heavily influenced by cases with matching M. tuberculosis genotypes among homeless Cincinnati residents, causing 21%, 30% and 39% of annual TB morbidity, respectively. While the 1990 organisms were not recoverable for subsequent genotyping, different genotypes were found in the two recent outbreaks (PCR 00874 in 1999 and PCR 00021 in 2007). The 2007 cluster includes 10 cases of TB diagnosed among residents of two large urban homeless shelters in Ohio, 7 of whom were also HIV-infected. Since then, 7 more cases with PCR 00021 have been diagnosed, including 4 cases in Indiana (one of whom PPD converted after staying at the Cincinnati homeless shelter and was likely the source of the other Indiana PCR00021 cases), one other PPD converter from the Cincinnati homeless shelter who was diagnosed with TB at an Ohio penitentiary, and one other HIV-infected person.

Methods: Although complete extent of HIV infection status among the TB-exposed homeless was not available, the HMIS of the Cincinnati/Hamilton County Continuum of Care contained confidential information about disabling conditions in the chronically homeless including self-identified diagnosis with AIDS or having tested positive for HIV (2.5% [135 of 7298] unduplicated persons in 2007). The local HMIS Advisory Committee created a TB Control Policy that permitted release of information requested by the County TB Control Program to the Health Commissioner in a manner consistent with strict confidentiality standards.

Results: Contact investigation of 9 of the 10 TB-exposed chronically homeless individuals who had identified themselves as being HIV-infected in HMIS revealed 5 TB cases, 2 TB skin test converters, and 2 lost to follow-up for an attack rate of 78% (7/9).

Conclusions: A high attack rate among HIV-infected homeless individuals exposed to TB was found using HMIS information. This information was useful in case detection, contact investigation, and in offering preventive treatment. TB screening after exposure in a homeless shelter can be difficult, often due to transient shelter residence. This pilot project explores the feasibility of including information about TB exposure and need for TB screening into HMIS records of homeless individuals.
Tuberculous and Non-Tuberculous Mycobacteria: A Single Center Prevalence Study

Gowri Satyanarayana MD, Scott Heysell MD, MPH, Ken Scully MS, Eric Houpt, MD.
University of Virginia, Charlottesville, VA

Background: There is substantial need to understand the epidemiology of mycobacterial infections, including demography, species distribution and pathogenesis. Clinical distinction of Mycobacterium tuberculosis (MTB) from NTM can be challenging, thus constructing specific diagnostic algorithms based on regional epidemiology may be useful.

Methods: The University of Virginia Clinical Data Repository was queried for "mycobacteria" or "acid-fast bacilli." Clinical information obtained for each patient included sex, age, site of infection, co-morbidities, antibiotic treatment, susceptibility test results, and chest computed tomography (CT) findings at time of specimen collection. Sites of infection were categorized as lung; skin, soft tissue, and bone (SSB); disseminated, if ≥2 specimens came from different sterile sites; lymphatic; other sites; and health care associated, which included infections in indwelling catheters, peritoneal cavity, or wounds.

Results: From 01/01/2001-08/31/2009, there were 2825 reports of mycobacteria or acid-fast bacilli, representing 492 unique episodes of infection from 467 different patients, of which 457 had complete clinical information available. Lung was the site of infection in 363 (79%), followed by SSB in 34 (7%), disseminated in 29 (6%), lymphatic in 15 (3%), health-care associated in 10 (2%) and other in 10 (2%). M. avium complex was the most common species found in 202 (41%) of infections and over-represented in the lung. M. marinum was exclusively found in SSB. Among pulmonary patients, MTB was found in 21 patients and was more likely in immigrants (p<0.001) and those without underlying immunocompromise or lung disease compared with NTM patients (p=0.002). CT findings were available for 244 patients with pulmonary specimens; compared to patients with NTM, those with TB were more likely to have cavities (p=0.01) and pleural effusion (p=0.005). An immigrant with pleural effusion on CT scan had a post-test probability of TB of 98.2% in this setting.

Conclusions: Mycobacterial infections are common at our center and demonstrate a trend toward an increase annual incidence. A simple diagnostic algorithm can aid in predicting MTB versus NTM in patients with pulmonary mycobacterial infection.
ABSTRACT 24

Therapeutic Drug Monitoring for Slow Response to Tuberculosis Therapy in a State TB Control Program

Scott K. Heysell1; Jane L. Moore2; Suzanne J. Keller2; Eric R. Houpt1
1University of Virginia
2Virginia Department of Health

Background: Therapeutic drug monitoring (TDM) may be useful in TB management, but programmatic implementation is understudied. In Virginia, slow responders to TB treatment have TDM tested.

Methods: A retrospective cohort study among patients slow to respond to treatment for drug-susceptible pulmonary TB in the state of Virginia was performed to determine the prevalence of low levels of isoniazid, rifampin, ethambutol and pyrazinamide measured at the time of estimated peak serum concentration (Cmax). Slow response was defined as a patient who after 30 days had ≥2 of the following findings: sputum smear positive for acid fast bacilli; no improvement in TB symptoms; no improvement in TB-specific chest x-ray lesions. Secondary investigations were risk factors for low levels, the mean change and likelihood of achieving a normal level following dose adjustment, and to compare outcomes between slow responders with low and normal levels.

Results: From 3/1/07 to 5/1/09, 311 patients were treated for drug-susceptible pulmonary TB, of which 42 (14%) patients were slow to respond. In multivariate analysis, diabetes was the only predictor of slow response (p<0.001). All 42 slow responders were tested for rifampin Cmax and 22 (52%) were low compared to reference norms; 39 had testing for isoniazid with 23 (59%) low; 26 had testing for ethambutol with 8 (31%) low; 20 had testing for pyrazinamide, all were normal. Diabetics were more likely to have a low rifampin level (p=0.03). Dose adjustment of rifampin was more likely to elevate Cmax to the target range than adjustment of daily-dosed isoniazid (p=0.01). Slow responders with a corrected low rifampin level had shorter median duration of therapy by 7 weeks (log-rank p=0.17).

Conclusions: TDM among slow responders identified the majority had low Cmax levels of rifampin and isoniazid while many had low ethambutol levels. Given the ease in correcting low rifampin levels and the shorter duration of therapy in those with a corrected level, rifampin is appealing to target for programmatic implementation of TDM. Further studies should evaluate TDM for rifampin early in treatment among all diabetics or higher initial doses of rifampin among groups at risk of slow response.
ABSTRACT 25

TB Drug Susceptibility Test using PMA Qpcr

Suporn Pholwat, Scott Heysell, Suporn Foongladda, Eric Houpt
University of Virginia

Background: The slow turnaround time for drug susceptibility results is a barrier to care. Rapid molecular testing based on sequence analysis of antibiotic target genes, such as rpoB, katG, gyrA, and rrs, has made gains, however gene target data do not completely correlate with phenotypic drug resistance, and for many drugs the genes of interest are unknown. We therefore sought to develop a rapid PCR-based phenotypic drug susceptibility assay that utilizes amplification of Tb 16S rRNA gene after 3 days of incubation with drug.

Methods: To decrease background DNA, we used propidium monoazide (PMA), a highly selective DNA binding dye that penetrates only into dead bacterial cells and renders DNA unamplifiable. The optimum PMA concentration was determined using live and heat killed cells prior to DNA extraction. Clinical Tb isolates were tested for drug susceptibilities to first and second line drugs using the agar proportion method. Drug susceptibilities were performed in broth media and sampled for viability of cells from day zero through day three followed by treatment with PMA prior to DNA extraction and qPCR amplification. The Ct values were observed at day zero through day three and compared with agar proportion method.

Results: We tested drug susceptibilities using the susceptible strain H37Rv, 10 susceptible clinical isolates, as well as 5 MDR and 1 XDR isolates. 16S rRNA qPCR Ct values exhibited the expected decrease in the presence of growth (either in the absence of drug or in the setting of drug resistance) while qPCR Ct increased or was not changed in the setting of drug susceptibility (killing). We calculated a growth index ($2^{\Delta Ct_{\text{control}}}/2^{\Delta Ct_{\text{drug}}}$) that represents DNA replication in control media vs. DNA replication in drug, where a positive value represents excess replication in media. A cutoff value of 2-10 yielded a sensitivity and specificity of >80% for isoniazid, rifampin, amikacin, kanamycin, capreomycin, ciprofloxacin, ofloxacin, ethionamide, and PAS versus agar proportion drug susceptibility results.

Conclusions: This PMA treated qPCR assay may be useful as a rapid 3-day drug susceptibility test for first and second line drugs.
Effectiveness of airline passenger contact investigations, New York State (NYS)

Cummings, M.¹, Kearns, C., MPH¹, Oxtoby, M., MD², Hughes, S., PhD¹
¹New York State Department of Health
²Centers for Disease Control and Prevention, Division of TB Elimination

Background: WHO guidelines recommend persons with infectious TB refrain from commercial air travel and passengers in close proximity to an infectious pulmonary TB case on an airplane be notified and evaluated. Aside from a few situations where transmission during air travel was implicated, studies have been unable to find evidence for this occurrence. With limited resources, many have questioned the value of tracing and evaluating air travel contacts.

Methods: Pulmonary Tuberculosis cases traveling on flights lasting ≥ 8 hours are reported to the Division of Global Migration and Quarantine if they were considered infectious at the time of travel. Locating information for passengers is forwarded to the state health department for follow-up. Seventy-five percent of flights were of non-US origin and foreign-born status was confirmed for 6 index cases on the 16 US origin flights, so results were compared to NYS foreign-born contact investigations between 2006 and 2008 (years with the most complete follow-up information).

Results: Between February 2008 and December 2009, NYS (excluding NYC) received 81 air travel investigation requests with 186 contacts. More than half (53.1%) of these were received > 90 days after the flight exposure occurred. Of the 186 contacts, 55 (29.6%) had insufficient locating information and no follow-up was received for 68 (36.5%), leaving 63 (33.9%) contacts evaluated, less than half as many as with standard contact investigations for infectious foreign-born cases (78.2%). Only 28.6% (N = 4/14) of air travel contacts evaluated and found positive started TxLTBI compared to 81.7% of those resulting from foreign-born contact investigations. No active disease was diagnosed for any air travel contact.

Conclusion: Contact investigations are resource intensive and investigating air travel contacts reduces staff time available for other priorities. Due to the lag of many months between the flight and notification of TB exposure and the reliance on obtaining airline manifests, this evidence suggests allocation of resources toward airline contact investigations may be more efficiently applied to other TB control measures.
ABSTRACT 27

Utilizing Nebraska's National Electronic Disease Surveillance System (NEDSS) for Latent Tuberculosis Infection (LTBI) Surveillance and Treatment

Alison R. Keyser, MPH, Pat Infield, RN, Thomas J. Safranek, MD
Division of Public Health, Nebraska Department of Health and Human Services, Lincoln, NE

Background: Tuberculosis remains a major public health priority in the United States. Treatment of latent tuberculosis infection (LTBI) plays a critical role in the US's reduction/elimination strategy, as most TB disease represents reactivation of LTBI. A primary goal of LTBI treatment is to achieve high completion rates among patients. Completion rates in published literature range between 20-65%. In 2005, Nebraska Department of Health and Human Services developed an LTBI program to provide free INH to all Nebraska LTBI patients. We utilized Nebraska's NEDSS to track the epidemiology and treatment of LTBI patients in Nebraska.

Methods: Since January 1, 2005, all LTBI patient visits are recorded in NEDSS, with the number of INH pills provided at the visit. NEDSS data was analyzed using SAS statistical software. We defined successful treatment as any patient who received >= 180 pills within 9 months. We assessed whether the 2008 completion rates varied by country of birth, primary language, age, and volume of LTBI patients a physician or clinic sees.

Results: A total of 4,021 people were enrolled in the LTBI program from 2005-2009. Enrollees ranged in age between 1 and 83 with the following distribution: 0-4 yrs (1 %), 5-19 yrs (22 %), 20-39 (57 %), 40-59 (17 %), 60+ (3 %). Foreign-born persons accounted for 92% of enrollees, and the distribution of primary language was: Spanish (46 %), English (30 %), Karen (8 %), Somali (4 %), and others (11 %). For the 757 enrollees in 2008, there was no statistical difference in completion rates by age group, primary language, country of birth, or volume of LTBI patients treated at a clinic. The overall completion rate was 38% with a range of 0%-63%.

Conclusion: Targeted tuberculin testing and treatment of latent tuberculosis infection is critical for the elimination of TB in the United States. Using NEDSS we are able to effectively track and define the characteristics of enrollees in Nebraska's LTBI program. NEDSS was originally developed to track reportable diseases but the developers created functionalities that allow us to track LTBI treatment and identify areas where improvement is needed. Completion rates varied widely between clinics; this system enables us to work with clinics with the goal of improving completion rates.
ABSTRACT 28

Multistate Outbreak of Multidrug-Resistant Tuberculosis among Foreign-Born Seafood Production Workers Identified by Genotype Cluster Investigation

Pennan M Barry, California Department of Public Health; Tracie J Gardner, Centers for Disease Control and Prevention; Elizabeth Funk, Alaska Department of Health and Social Services; Eyal Oren, Public Health Seattle and King County; Kimberly Field, Washington State Department of Health; Tambi Shaw, California Department of Public Health; and Adam J Langer, Centers for Disease Control and Prevention

Background: Tuberculosis (TB) among foreign-born persons is often assumed to be acquired outside the United States; however, many foreign-born persons have risk factors for acquiring TB domestically such as living and working in crowded conditions with other high-risk persons. Progress toward universal TB genotyping has facilitated genotype cluster investigations.

Methods: Genotyping used spoligotyping, 24-loci Mycobacterial Interspersed Repetitive Units - Variable Number of Tandem Repeats (MIRU-VNTR), and IS6110-based Restriction Fragment Length Polymorphism (RFLP) analyses. Cases with similar genotypes (spoligotype and 12-loci MIRU-VNTR) were identified using California and national genotype databases. Investigators reviewed public health and employer records and reinterviewed patients.

Results: Investigators identified three foreign-born multidrug-resistant (MDR) TB cases with matching genotypes and drug-susceptibility patterns, but no known epidemiologic links: two in California (born in Asia and Latin America) and one in Washington (born in Africa). Subsequent investigation revealed that all three patients were employed as seafood production workers in Alaska during the 28 months before TB diagnosis. Investigators subsequently identified an African-born Alaska resident with infectious MDR-TB who was a seafood production worker at the time of TB diagnosis in 2006; this putative source case’s genotype matched the other patients’ spoligotype, but differed at one locus in the 12-loci MIRU-VNTR. Subsequent 24-loci MIRU-VNTR and RFLP matched completely among all four cases. Employer records confirmed that all worked in the same seafood production facility concurrently in 2006. None of the three secondary cases were identified during the source case’s 2006 contact investigation which included living quarters but not workplace contacts. Contact investigation of the secondary cases included 47 contacts: 23 (49%) had positive skin-tests; two had active disease (culture-negative pediatric). No additional cases have been identified.

Conclusions: Investigation of genotype clusters can identify previously unrecognized outbreaks. Drug-susceptibility results can be useful for focusing contact investigation resources to identify epidemiologic links. Epidemiologic links should not be ruled out among patients with closely related, but not identical, genotypes. Workplaces with many foreign-born workers can be sites of TB transmission and thus locations for TB prevention efforts. TB control programs should remain alert for domestic transmission of TB among foreign-born persons.
Reaching a Global Audience: Evaluating and Improving the TB Education and Training Resources Website

Allison Maiuri¹, Amera Khan¹, Sarah Segerlind¹, Miriam Mendenhall²
¹Centers for Disease Control and Prevention, Atlanta, GA, USA
²Danya International, Inc., Silver Spring, MD, USA

Background: Launched in 2003, the TB Education and Training Resources Website (www.findtbresources.org) provides a central, comprehensive searchable database of U.S. and international tuberculosis (TB)-related education and training materials for health professionals, persons with or at risk for TB, and communities or the general public. Evaluation is essential to ensure the site is accessible and determine how frequently it is being used. An assessment of the site’s usability and effectiveness was conducted to identify potential improvements and enhancements to better meet the changing needs of users.

Methods: The evaluation involved monitoring web usage statistics from the last five years and gathering qualitative feedback on the site. To further supplement this evaluation data, structured usability testing was conducted in April 2009. Objectives of the usability test were to assess the ease and efficiency of navigating the site, as well as users' expectations and satisfaction with site content and function. Usability participants were recruited from international and U.S. partner organizations.

Results: The website database contains over 2,100 TB education and training materials. Since 2003, the site has received approximately 782,285 visits from users in over 100 different countries. The usability testing gathered feedback on navigational elements, page layout, content presentation, information organization, search functionality, and results presentation.

Conclusion: Evaluation data show that the website is being accessed by both U.S. and international target audiences. Findings and recommendations from the usability test are being used to further improve the website and identify modifications to enhance global users' ability to easily and successfully search the databases to locate needed TB education and training materials.
Acceptability of Interferon-Gamma Release Assays among Healthcare Workers who Receive Routine Employee Tuberculosis Testing

Hirsch-Moverman Y1, Wall K2, Maiuri A3, Khan A3, Munk E4, Weinfurter P5, DeLuca N3 and the TB Epidemiologic Studies Consortium
Columbia University1, Denver Health and Hospital Authority2, Centers for Disease Control and Prevention3, John Hopkins University4, Westat5

Background: Healthcare workers (HCWs) are considered to be at risk for exposure to M. tuberculosis (TB), and are often tested serially for latent TB infection (LTBI) through occupational health programs. The Centers for Disease Control and Prevention (CDC) recommends using either an intradermal tuberculin skin test (TST) or a blood-drawn interferon-gamma release assay (IGRA) to test for LTBI. IGRA offer many advantages over TSTs, but as they are relatively new diagnostic tests for LTBI, little is known about their acceptability among HCWs.

Methods: Adult HCWs at 4 sites in the U.S. were enrolled in a study to receive a TST and Quantiferon-Gold in-tube (Cellestis) and T-SPOT.TB (Oxford Immunotec) at 6 month intervals for 18 months. The first 100 participants enrolled at each site were asked to respond to an acceptability questionnaire. The tool consisted of 13 questions designed to elicit participants’ attitudes regarding the use of TSTs and IGRA; their confidence in results of each test; and their likelihood of taking LTBI treatment based on results of either test.

Results: At baseline, 407 participants were administered the acceptability questionnaire; data is currently available on 342 participants. Of these, 74% never heard of IGRA. Participants were given brief information about each test. Belief in a hypothetical positive result by TST or IGRA was similar (68% vs. 74% respectively), as well willingness to accept LTBI treatment (79% for both). Accuracy of results was highlighted as the most important factor (59%) in test preferences, followed by fear of side effects (18%). Overall, participants preferred the IGRA to the TST (52% vs. 20%; 28% had no preference). When presented with hypothetical discordant results, HCWs expressed more confidence in IGRA results compared to TST results.

Conclusions: Although HCWs indicated preference for IGRA over the TST and further expressed confidence in IGRA results compared to TST results, the likelihood that HCWs would initiate LTBI treatment based on positive results from either test remained the same. Further studies are needed to determine if IGRA positive results will have any impact on HCWs actual acceptance of LTBI treatment.

Funding source: Centers for Disease Control and Prevention through the TB Epidemiologic Studies Consortium
ABSTRACT 31

Educational Messages for Tuberculosis Program Clients: How Might We Improve?

Katie Rowan MPH\textsuperscript{1,2}, Jane L. Moore RN, MHSA\textsuperscript{3}, Lauri S. Savage MBA\textsuperscript{3}, Brenda F. Mayes RN\textsuperscript{3}, Donna H. Wegener MA\textsuperscript{2}, Michael Lauzardo MD, MSc\textsuperscript{2}, Joan M. Mangan PhD, MST\textsuperscript{1,2}  \hspace{1cm}  \textsuperscript{1}Lung Health Center, University of Alabama at Birmingham (UAB), USA; \textsuperscript{2}Southeastern National Tuberculosis Center, University of Florida, USA; \textsuperscript{3}Virginia Department of Health, Division of Disease Prevention, TB Control and Prevention, USA

Background: Tuberculosis is highly stigmatized and poorly understood in many regions of the world. Consequently, foreign-born individuals who receive educational information that appears logically inconsistent with their own long-held attitudes, beliefs, and practices may experience dissonance, engage in avoidance behaviors or modify misperceptions to reconcile old information with new.

Methods: During cultural competency trainings, patient-provider scenarios were presented to program managers, nurses, nursing assistants and outreach workers. Fifty-five staff, working individually or in pairs, wrote down messages they would communicate with clients to: (1) address common misperceptions about TB etiology, transmission, and treatments; (2) explain the need for diagnostic testing or the validity of a TB diagnosis despite BCG vaccination; and (3) diminish fears of being stigmatized. Messages were then analyzed.

Results: The majority of these messages could be grouped into either one or a combination of the following categories: (1) provide facts; (2) explain negative consequences; (3) acknowledge existence of misperceptions/practices; (4) establish rapport; (5) sympathize; (6) provide reassurance anyone can be affected; (7) explain US approach to TB control; (8) identify information source as credible (i.e. CDC).

Staff infrequently wrote an explanation concerning why a misperception was incorrect or a practice was potentially harmful. When they did, more often it was in response to the use of traditional treatments and BCG vaccine misperceptions; some messages lacked coherence.

Conclusion: Guidance in elucidating and dispelling common misperceptions related to TB may enhance staff members’ capacity to persuade clients to attend to and accept new knowledge, and diminish the dissonance clients experience.
ABSTRACT 32

Effective Cross-Cultural Interactions with Foreign-Born Clients: A Needs Assessment of Tuberculosis Program Staff

Katie Rowan, MPH1,2, Jane L. Moore RN MHSA3, Lauri S. Savage MBA3, Brenda F. Mayes RN3, Donna H. Wegener MA2, Michael Lauzardo, MD MSc2, Joan M. Mangan PhD, MST1,2
1Lung Health Center, University of Alabama at Birmingham (UAB), USA; 2Southeastern National Tuberculosis Center, University of Florida, USA; 3Virginia Department of Health, Division of Disease Prevention, TB Control and Prevention, USA

Background: To ensure the provision of culturally competent care and services to foreign-born clients, healthcare providers are challenged to gain: (1) an awareness of clients’ values, beliefs, practices and (2) insights to collect relevant health history and assess clients’ psycho-social and educational needs.

Methods: Formative research was conducted to develop a quick-reference, "field" version of an educational product designed to provide TB program staff information needed to engage in effective cross-cultural interactions with foreign-born clients. Staff who attended trainings in Virginia were provided a list of 51 potential topics to be included in the product and invited to suggest additional topics. Working in pairs, staff selected all topics they would want to review immediately prior to meeting with a new client from a country of which they had little or no knowledge, then ranked the topics in order of perceived importance.

Results: Fifty-five staff, including program managers, nurses, nursing assistants and outreach workers participated in the exercise. Topics frequently identified as most important were: cultural courtesies, languages spoken in the country, communication patterns, important patient education points, misperceptions of TB etiology transmission and treatment, stigma, literacy levels, and non-medical treatments used within clients’ birth-countries.

Conclusion: The informational needs TB program staff members reported regarding the culture and customs within clients’ birth-countries, as well as TB-specific misperceptions, may enhance staff capacity to deliver culturally competent care to an increasingly diverse client population.
ABSTRACT 33

Eliminating Borders in Tuberculosis Surveillance

Sandra Morano, B.A.,RN, TB Coordinator, and Olga Brown, B.S.N., M.P.H., M.A., Director of Nursing and Dental Hygienists Services, City of Stamford, CT
Danielle Orcutt, M.P.H., Epidemiologist, and Maureen Williams, M.A. Nurse Consultant, State of Connecticut Department of Health, TB Control Program

Learning Objectives:

1. Recognize the effectiveness of an interdisciplinary team in the analysis of information and identification of new active tuberculosis cases and their contacts.
2. Apply methods of joint meetings, newsletters, phone conversations, autopsy reports, interstate referrals and investigational follow up in their community to maintain quality TB surveillance.
3. Identify the need for early identification and treatment of active and latent TB to prevent its transmission.

The Tuberculosis Control Program in the City of Stamford processed 235 new latent cases and 12 new active cases in 2007. This represents 40% and 71% increase respectively from 2006. Stamford, CT, located 25 miles outside of New York City, has a population of 117,000.

The purpose of this abstract is to demonstrate how interdisciplinary team analyzed information gathered during contact investigations and identified increased numbers of active and latent cases in the community. This team included: the Health Department TB nurse coordinator, State TB Nurse Consultant, State Epidemiologist, Nursing Director, Health Director, federal and local Pulmonologists, state and local laboratories, local hospital Infectious Disease Nurse, Radiologists and Pharmacists.

In July of 2007 there was information surrounding active TB cases that pointed to epilinks between cases in our local community. Methods used to link the cases were sputum specimens, genotyping cultures, autopsy reports, active listening skills while interviewing patients, utilizing interstate health departments, communication via conference calls, meetings and a newsletter. In addition the Public Health TB Nurse’s Education program increased client trust leading to additional contacts.

Benefits of forming an interdisciplinary team include early identification of additional active and latent cases and the establishment of a multi-agency team that remains "at the ready" to prevent future TB outbreak. Networking within the local, state and federal health-related agencies, should be embraced by every local health department to eliminate borders in public health practice in general, and TB surveillance in particular.
ABSTRACT 34

Nutritional Assessment of TB Patients and Therapeutic Interventions: Translating Research into Practice

Catalina Navarro, Alisha Blair, Debbie Onofre, Elizabeth Mauldin, Barbara Seaworth
Heartland National TB Center

Background: In 2007, Heartland National TB Center (HNTC) recognized the need to train health care providers on the impact of nutrition and low BMI on TB treatment outcomes. Research including the TBTC Study noted treatment outcomes in individuals < 10% of their ideal body weight at TB diagnosis or with BMI< 18.5 had worse outcomes including treatment failure and relapse. Outcomes were especially poor in those who did not regain 5 % of their weight by two months

Methods: HNTC performed an informal assessment of knowledge regarding nutrition and TB outcomes. Nurses were not aware of new research although believed nutrition was important. A need for additional knowledge and skill building was identified. Education was delivered on new research tying TB treatment outcomes to baseline nutrition and ability to gain weight during early treatment months via lectures, case studies and reinforced with an educational product. Participants were encouraged to monitor weights and BMI of TB patients, to encourage interventions to improve nutrition, and consider changes in treatment duration and dosing intervals in high risk patients. A survey was sent to those who participated in training in 2007.

Results and Findings: Most participants reported ongoing changes in practice related to this training > 2 years later. Use of BMI charts was less uniform although all reported attention to baseline weight and weight gain. Changes in patient treatment regimens are more difficult to study but some participants did report discussions with providers identifying need for longer treatment or more frequent dosing in high risk patients.

Conclusions: Results suggest that educational efforts that translate research findings into ways to modify current practice are accepted by trainees, result in long term changes in practice, and enhance patient outcomes.

Margaret Patterson1, Maria Dalbey1, Teresa Goins2, Adam Langer2, Roque Miramontes2, Susan Petty3, Matt Zahn3

1Kentucky Department of Public Health, 2Centers for Disease Control and Prevention, 3Metro Department of Health and Wellness

**Background:** From 1998 through 2009, 26 tuberculosis (TB) cases with the PCR02118 genotype (spoligotype 777767577607771, MIRU 22335143324; KY_0011 cluster) were reported in Jefferson County, Kentucky.

**Methods:** The Kentucky TB Laboratory submitted all available isolates from Jefferson County that had not already been genotyped to the National TB Genotyping Service. Investigators described characteristics of cases using data from the National TB Surveillance System (NTSS). Patient files were reviewed to confirm NTSS data and identify epidemiologic links among cases.

**Results:** Review of patient records identified a likely source case. The patient was initially diagnosed in 1998 followed an extended symptomatic period, resulting in cavitary, smear-positive TB disease. After the 1998 diagnosis, the patient was initially nonadherent to treatment recommendations, had an unstable housing situation, and excessively consumed alcohol and used illicit drugs. In addition, this patient was diagnosed with a second episode of TB disease in 2005. The patient also reported epidemiologic links to several other patients in the cluster. To examine differences in secondary patients diagnosed after each of the source patient’s TB disease episodes, investigators divided the descriptive analysis of patients into two groups: patients diagnosed during 2000–2004 and 2005–2009. The nine cases reported during 2000–2004 had a median age of 46 years and included one (11%) homeless person, four (44%) persons with excess alcohol use, two (22%) injecting drug users, two (22%) non-injecting drug users, two (22%) HIV-positive persons, and six (67%) smokers. Of the 20 cases reported 2005–2009, the median age was 49 years and there were seven (35%) homeless, 11 (55%) excess alcohol users, eight (40%) injecting drug users, eight (40%) non-injecting drug users, three (15%) HIV-positive persons, and 16 (80%) smokers. All patients were U.S.-born and predominantly non-Hispanic white.

**Conclusions:** This investigation demonstrated the potential for a single "superspreader" of TB infection to cause a large outbreak in a community. Clustering of cases with a single genotype indicated likely recent transmission in the community and prompted an investigation. The investigation confirmed a large localized outbreak, and state and local TB control programs are working to interrupt transmission and terminate the outbreak.
ABSTRACT 36

Five Years of Follow-up and Treatment for Contacts to Tuberculosis Cases: Aggregate Reports for Tuberculosis Program Evaluation, United States, 2003–2007

Brandy L Peterson, John Jereb, Kai Young, Awal Khan
Division of Tuberculosis Elimination, Centers for Disease Control and Prevention, Atlanta, GA

Background statement of problem or objectives: From 2003 to 2007, 70,418 cases of tuberculosis (TB) were reported in the United States. A key strategy for finding secondary cases and latent TB infections (LTBI) is investigating exposures to contagious cases. Contacts of cases with acid-fast bacilli seen on sputum microscopy (AFB+) are most likely to be infected and are assigned high priority for screening. The 2015 national objective is 93% for medically evaluating contacts of AFB+ cases and is 79% for completing LTBI treatment. Monitoring and evaluating contact investigations are essential to enhancing prevention.

Methods: Of 68 U.S. TB control jurisdictions, 43 (63%) consistently reported findings from contact investigations, 2003-2007, via the Aggregate Reports for Tuberculosis Program Evaluation, which includes definitions for TB disease and case, contact, LTBI, and started and completed treatment. Findings from investigating AFB+ index cases only are presented here.

Results and Findings: For 19,294 AFB+ index cases investigated over the 5-year period, 288,173 contacts (14.9 contacts per case) were elicited. Averaged over the period, 81% of contacts were evaluated, of which 1% had TB disease and 23% had LTBI. Of 54,688 contacts with LTBI, 71% initiated treatment for LTBI, of whom 63% completed therapy.

Contact Counts and Indices from Investigating 19,294 AFB+ Index TB Cases, 43 U.S. Reporting Jurisdictions, 2003–2007

<table>
<thead>
<tr>
<th>Year</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>Objective</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Contacts</td>
<td>57860</td>
<td>63002</td>
<td>53257</td>
<td>53997</td>
<td>60057</td>
<td></td>
</tr>
<tr>
<td>Contacts per Case</td>
<td>13.9</td>
<td>15.1</td>
<td>14.5</td>
<td>14.2</td>
<td>16.9</td>
<td></td>
</tr>
<tr>
<td>Index Cases with no Contacts</td>
<td>7%</td>
<td>8%</td>
<td>8%</td>
<td>8%</td>
<td>7%</td>
<td></td>
</tr>
<tr>
<td>Contacts Evaluated</td>
<td>81%</td>
<td>82%</td>
<td>82%</td>
<td>81%</td>
<td>81%</td>
<td>93%</td>
</tr>
<tr>
<td>Contacts with TB Disease</td>
<td>1%</td>
<td>1%</td>
<td>1%</td>
<td>1%</td>
<td>1%</td>
<td></td>
</tr>
<tr>
<td>Contacts with LTBI</td>
<td>25%</td>
<td>24%</td>
<td>23%</td>
<td>22%</td>
<td>23%</td>
<td></td>
</tr>
<tr>
<td>Started Treatment</td>
<td>72%</td>
<td>70%</td>
<td>69%</td>
<td>72%</td>
<td>68%</td>
<td>88%</td>
</tr>
<tr>
<td>Completed Treatment</td>
<td>58%</td>
<td>60%</td>
<td>64%</td>
<td>66%</td>
<td>68%</td>
<td>79%</td>
</tr>
</tbody>
</table>

Conclusions: The indicators for evaluation of contacts and initiation and completion of treatment are falling short of national objectives, and they show little progress. All jurisdictions should regularly review data on contact investigations locally to discover the barriers to achieving
optimal results and to design effective interventions.
ABSTRACT 37

Tuberculosis Treatment Completion in Tennessee

April C. Pettit, MD1, Jason Cummins, MPH2, Timothy R. Sterling, MD1, Jon V. Warkentin, MD, MPH2

1Division of Infectious Diseases, Department of Medicine, Vanderbilt University School of Medicine, Nashville, TN; 2Tennessee Department of Health, Nashville, TN

Background: Failure of tuberculosis (TB) patients to complete therapy in a timely manner leads to a potentially preventable excess in TB morbidity and mortality, and M. tuberculosis transmission. A key TB program performance objective established by the Centers for Disease Control and Prevention is that at least 90% of TB cases complete anti-TB therapy within 12 months, provided that one year or less is indicated.

Methods: We conducted an observational cohort study among all TB cases reported to the Tennessee Department of Health between January 1, 2000 and December 31, 2007. Cases were excluded if there was drug resistance, central nervous system (CNS) or bone/joint disease, or if the patient was not initiated on isoniazid, a rifamycin, or pyrazinamide. Time to complete therapy was calculated using therapy start and stop dates documented in the Tuberculosis Information Management Systems database (TIMS). Charts were reviewed for all cases requiring more than 12 months to complete therapy to determine causes for delay.

Results: Of 1,854 cases, 158 (8.5%) required more than 12 months to complete therapy. Persons with treatment completion delay were more likely to be black, foreign-born, HIV-infected, reside in a correctional facility, or use alcohol. Additionally they were more likely to be smear positive, culture positive, and have cavitary disease on chest radiography.

Charts were reviewed for 146 patients requiring more than 12 months to complete therapy (12 charts were missing or incomplete). There were 7 cases (5%) with CNS or bone/joint involvement which was not documented in TIMS. Treatment completion was prolonged in 21 (14%) cases due to drug-induced hepatotoxicity, 27 (18%) cases due to documentation of low drug levels, 33 (23%) cases due to drug intolerance, and 9 (6%) cases due to drug allergy. Non-adherence to therapy played a role in treatment completion prolongation in 58 cases (40%).

Conclusions: In this cohort, the proportion of TB cases completing treatment within 12 months (91.5%) was above the goal set by the CDC. However, it could be increased with efforts to detect low drug levels earlier during therapy and improved patient adherence to therapy.
ABSTRACT 38

Coloradoans are "On the Move to Eliminate TB" at the 2nd Annual "Stop TB Trot"

Lucy Arenas, Carolyn Bargman, Randall Reves - Denver Metro TB Clinic
Kerri McClory - Colorado Public Health Department

TB Clinic patients come from 7 counties in the Denver metro area and are comprised of refugees, homeless and high-risk persons with social and health concerns and few resources. While the clinic furnishes TB services and treatment free of charge, our resources fall far short of meeting client's needs. To bridge the gaps our team has improved linkages to organizations providing social services.

Over the past year, TB clinic staff referred patients to social workers, homeless shelters, food banks, community and faith based organizations, school nurses and family planning as well as our own integrated hospital system including 24 community and school based health clinics, an HIV clinic and a 625 bed hospital. The TB Clinic provides bus tokens, grocery coupons and arranges free hotel rooms for those patients isolated with contagious tuberculosis and no safe housing. These efforts are often not enough. Patients get lost coming to the clinic and have no transportation or money for a taxi in a blizzard. Often patients have to wait, with no food, approximately 8 hours for an available hospital bed.

With the remnants of a foot of snow that fell in Denver 2 days before and despite a chilly spring over 200 residents from the Denver area arrived at a local park to run/walk in the 2nd Annual "Stop TB Trot". This 5K race held on March 21st in honor of World TB Day was an effort to increase awareness about TB and raise funds for patients. Employees from the TB Clinic, State Health Department and Colorado Coalition against TB pitched in to organize the event. Employees of other local health departments joined to participate as runners, walkers and volunteers. Donations were received from a number of local businesses and one large corporate sponsor, Cellestis, the maker of QuantiFERON.

Results and Findings: The race garnered media attention and raised over $4000 for patient assistance.

Conclusions: Through a creative collaboration with organizations and individuals; awareness and funds were raised to enhance our program resources and to bridge the gap for our needy patients.
Implementation of a QuantiFERON-TB Gold Screening Program in a Public Health Clinic Setting

NiiAmah Stephens, MPH, CPH; Susan Dorman, MD; Sherry Ketemepi, MPH; Adena Greenbaum, MD, MPH; Nicketta Johnson, RN, BSN
Baltimore City Health Department (BCHD), Johns Hopkins Center for TB Research, Johns Hopkins Hospital

Background/Statement of Problem: For more than a century, the mainstay of latent tuberculosis detection has been the tuberculin skin test (TST). However, TST screening requires at least two interactions with a health worker, reading TSTs can be highly subjective, and result interpretation can be difficult among BCG-vaccinated individuals. Interferon-gamma release assays, such as the QuantiFERON-TB Gold (QFT-G) test, overcome these obstacles, may improve staff efficiency, and may be more cost-effective, but data on their use in public health clinic settings have been very limited.

Methods: The Baltimore City TB Control Program, BCHD's BDC Laboratory, and Johns Hopkins partners met several times over 6 months to design a pilot program that would assess the feasibility of QuantiFERON-based screening in BCHD TB clinics; evaluate impact on contact investigation completion rates; evaluate impact on screening of BCG-vaccinated individuals; and costs and cost-effectiveness of implementation in a routine TB program setting.

Results: Health Department staff and Hopkins partners developed Standard Operating Procedures detailing eligibility criteria for QuantiFERON screening, how and when samples will be collected, and how often batches will be run at the laboratory. Background materials were developed to explain the new test to clinic patients, and the test manufacturer trained nurses and laboratory staff on appropriate phlebotomy and analysis techniques. Program evaluation will use a retrospective cohort approach that enables modeling of clinical efficiency, program effectiveness, and cost-effectiveness. TB screening using QFT-G began in Baltimore City's Eastern District Health Center on March 1, 2010.

Conclusion: The initial implementation of QFT-G testing has been feasible in a local health department setting. Assessment of impact on patient-centered and program outcomes is underway. The data collected during this pilot program will be useful in determining the cost-effectiveness of broader QFT-G adoption.
ABSTRACT 40

The Tuberculosis Trials Consortium (TBTC) 2010–2020, a CDC-Sponsored TB Research Initiative for Finding Stronger, Shorter, Better TB Treatments

Margarita E. Villarino for the TBTC, Division of TB Elimination, Centers for Disease Control and Prevention

Background: CDC’s Tuberculosis Trials Consortium (TBTC) has as its goal the investigation of new anti-TB drugs and innovative management strategies to identify shorter, stronger, and safer treatments for TB patients worldwide. The TBTC is a funded collaboration of US-based and international researchers, drawn from public health departments, academic medical centers, and Veterans Administration medical centers. The TBTC was first established as a consortium in 1997. Since its inception, the TBTC has conducted 9 major clinical trials and diverse sub-studies associated with them, involving approximately 12,000 patient volunteers. Because its mission is defined as involving programmatically-relevant research, the TBTC has helped to strengthen the linkage between TB control programs and research initiatives and has contributed to evidence used to formulate new TB patient management guidelines.

Methods: In 2009, CDC conducted a formal re-competition for 10-year contractual membership in the TBTC. The competitive process was finalized in September 2009.

Results: A total of 20 sites (10 domestic and 10 international) were selected. TBTC’s third competitive process has expanded its international presence to sites in Brazil, Spain, South Africa, Uganda, Kenya, Vietnam, the Philippines, and China (Hong Kong). The TBTC 2010–2020 research group includes US sites in New Jersey, New York, Washington, DC, Texas (four sites), Colorado, Tennessee, and North Carolina. The domestic and international TBTC sites are linked, in that CDC awards funds for the international study sites through the US-based institutions that proposed them as partners in the competitive process.

Conclusion: Through 2020, the focus of TBTC patient enrollment will shift from sites located mostly in North America to sites located around the world. The multinational, collaborative nature of the TBTC provides a unique resource for testing new promising anti-TB therapies. The TBTC scientific agenda seeks to adapt to the discovery of new anti-TB agents in order to continue investigating and promoting improved TB treatment and prevention strategies for the benefit of patients globally.
Mycobacterium tuberculosis Infection among Employees of an Elephant Refuge

Rendi Murphree1,2, John R. Dunn2, Jon V. Warkentin2, William Schaffner3, Tim F. Jones2
1Epidemic Intelligence Service, Office of Workforce and Career Development, Centers for Disease Control and Prevention, Atlanta, Georgia; 2Communicable and Environmental Disease Services, Tennessee Department of Health, Nashville, Tennessee; 3Department of Preventive Medicine, Vanderbilt University School of Medicine, Nashville, Tennessee

Background: In October 2009, the Tennessee Department of Health was informed of tuberculin skin test (TST) conversions (n=5) among employees of an elephant refuge and isolation of Mycobacterium tuberculosis (Mtb) from a resident elephant. The refuge houses 16 elephants, including 7 quarantined since 2006 for exposure to Mtb. We investigated to determine the extent of the outbreak, identify risk factors for conversion, and prevent ongoing zoonotic transmission.

Methods: We conducted a cohort study among persons employed since 2006, including occupational health records review, TST screening, and standardized interviews. Barn management and husbandry practices were assessed onsite. Conversion was defined as a 0-mm induration TST followed by a TST of ≥5-mm induration in a refuge employee during January 2006–October 2009.

Results: Respondents included 30 elephant caregivers, 11 administrators, and 5 maintenance workers; 9 had TST conversion. Employees who worked at the quarantine facility during 2009 were at increased risk of infection (risk ratio, 20.3; 95% confidence interval, 2.8-146.7). Eight (62%) of 13 quarantine facility workers had conversion during 2009, including 5 caregivers and 3 administrators. Caregivers reported inconsistent use of respirators, and we observed practices (e.g., high-pressure washing) that likely resulted in aerosolization of excreted Mtb. Three administrators with TST conversion only worked in areas of the quarantine facility where respirators were not prescribed. Air flow between administrative areas and the infected elephant barn was unrestricted.

Conclusions: We describe zoonotic Mtb transmission from an elephant to humans. Immediate interventions included relocation of nonessential personnel, increased use of respirators, and infection control plan modifications. Occupational health guidelines addressing the unique housing and husbandry practices of elephants exposed to Mtb are needed to ensure caregivers’ protection.
Abstract 42

Lessons Learnt from a Contact investigation for TB Disease: A Costly Adventure

M. McCormick, MD, University of Kentucky
Andrew Waters, Epidemiologist, Lexington-Fayette County Health Department

Background: In 2009, a 34-year old Hispanic male was admitted to the University of Kentucky hospital with a history of fever, weight loss, productive cough with hemoptysis and was diagnosed with cavitary tuberculosis (TB); sputum showed 4+ acid fast bacilli. The index case lived in a crowded 2 room apartment. A contact investigation was initiated. The household and social contacts spanned 7 Kentucky counties and 2 states.

Methods: The concentric technique for identifying close contacts was utilized. A combination of clinical visits and field visits to the household and location of employment were used to provide screening of close contacts for symptoms of TB disease, risk factors for latent TB infection (LTBI), and collection of demographic data.

Close contacts identified with TB disease or LTBI were initiated on recommended therapy by the local health department (LHD) serving their county of residence. They were encouraged to complete recommended therapy but loss to follow-up care was identified.

Evaluation of success and cost-effectiveness of investigation was based on identification of additional TB disease and LTBI, completion of recommended therapy, and compliance with follow-up care.

Results: A total of 124 contacts, primary (21), secondary households (16) and co-workers (87) were identified. Two cases of TB disease were identified, (1.6%), both within the primary household. LTBI was identified in 58 (47.2%).

Of the 58 identified with LTBI, 22 (37.9%) reside within Fayette County. Nine of the 22 (40.9%) were started on recommended LTBI therapy. Three (33.3%) completed the recommended therapy and 6 (66.6%) were lost to follow-up care with an average therapy of 2.5 months. Similar results are expected in the remaining 36 (62.1%) of the 58 identified with LTBI.

The cost associated with the identification and successful treatment of 3 individuals with TB disease and 3 individuals with LTBI exceeded $8000.

Conclusion: The TB contact investigation described above, required close multi county and interstate collaboration was costly and time-consuming with little impact on LTBI therapy.
Nine Months of Therapy for Tuberculosis in California: Are Guidelines Being Followed?

Pennan M. Barry, L. Pascopella, J. Watt, J. Flood – Tuberculosis Control Branch (TBCB), California Department of Public Health (CDPH)

Background: Tuberculosis (TB) patients with cavitary disease and a positive sputum culture two months into therapy have a relapse rate as high as 21%. National guidelines recommend extending therapy from six months to nine months for these patients. We investigated the proportion of patients that received extended therapy as recommended and predictors of receiving extended therapy.

Methods: Data on adult culture positive pulmonary tuberculosis cases reported to the CDPH during 2004–2007 and who completed therapy were abstracted from the California Tuberculosis Registry. Patients with rifampin, ethambutol, or pyrazinamide-resistant disease; or for whom chest radiograph results were unknown were excluded. Delayed culture conversion was defined as no negative culture documented by 10 weeks of therapy (two weeks beyond the two-month standard). Treatment duration of ≥270 days was considered extended therapy. We applied published relapse rates to predict the number of relapsed cases expected to result from not extending therapy.

Results: Of 11,394 tuberculosis cases, 5213 met the inclusion and exclusion criteria. Of those, 1435 (27.5%) patients had a cavity on chest radiograph, 1159 (46.1%) patients had delayed culture conversion, and 430 (8.2%) patients had both a cavity and delayed culture conversion. Of patients with a cavity and delayed culture conversion, 323 (75.1%) received extended therapy; nearly all (92.1%) received at least some directly observed therapy. In unadjusted analysis of patient and provider characteristics, only isoniazid resistance was significantly associated with extended therapy: 90.9% among isoniazid resistant cases compared with 73.9% among pansensitive cases (P=.03). Among the 107 patients who did not receive extended therapy as indicated by national guidelines, 22 relapses are expected. Of 1661 patients who had a cavity or delayed culture conversion, 959 (57.7%) received extended therapy as recommended by California guidelines. Among the 702 patients who did not receive extended therapy as indicated by California guidelines, 60 relapses are expected.

Conclusions: A substantial number of TB patients do not have treatment extended to nine months as recommended. Further research is needed to determine reasons treatment is not extended. Interventions to increase the duration of therapy among those patients might reduce TB relapses.
Recorded Discordance Between Foreign and Domestic TST Results in Recently Arrived Class B2 Immigrants

Wolman, M1, Lardizabal A1, Davidow AL1,2, Sevilla A1
1New Jersey Medical School Global Tuberculosis Institute
2Department of Preventive Medicine & Community Health, New Jersey Medical School

Background: In 2007, the Centers for Disease Control and Prevention (CDC) published the Technical Instructions (TI) for overseas screening for tuberculosis (TB). The revised TI require overseas panel physicians to administer the TST or IGRA for persons between the ages of 2-14 applying for U.S. immigration status and who are living in countries with a TB incidence of >20 cases per 100,000 population. Asymptomatic children with a positive TST with a negative chest X-ray are now classified as B2.

Methods: We conducted a retrospective record review of B2 immigrants aged 2-14 years arriving in three New Jersey (NJ) counties with a large foreign-born population (approximately 580,000) between September 1, 2009 and March 25, 2010. The review consisted of comparing overseas TST results to that of U.S. TST results. The proportion of discordant TST results were calculated overall and by country of origin.

Results: Excluding those who moved or were not locatable, 69 immigrants reported for domestic evaluations. Further exclusions included those with no record of initial or repeat TST or were retested with QFT. Of the 46 records reviewed, 32 (69.5%) individuals immigrated for the Dominican Republic (DR), 11 (23.9%) from the Philippines, and 3 (6.5%) from other countries. There were 31 females (67%); 15 males (33%). Median age was 11 years. Overall, 58.7% of Immigrants with a foreign TST of >10mm had a repeat domestic TST of 0mm. The proportion of repeat TSTs recorded as 0mm was 62.5% and 62.6%, respectively, for the DR and the Philippines.

Conclusions: The striking discordance between foreign and domestic TST results among Class B2 immigrants from the DR and the Philippines raises questions about the validity of TST results in those countries. Improper administration of TST and/or misinterpretation of TST readings (erythema) may be the cause(s) of the discordance. It needs to be noted that the immigrant stream described herein did not allow an analysis of data from a wider variety of countries. A comprehensive review is recommended to address the root cause of this potentially widespread phenomenon.