COMMUNITY-BASED APPROACHES TO TUBERCULOSIS OUTBREAK RESPONSE IN NEW YORK CITY

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OVERVIEW

- TB genotyping, clustering, and outbreak investigation in New York City
- TB outbreak response in Sunset Park, Brooklyn, 2014-2015

TB GENOTYPING IN NYC

- NYC has performed universal genotyping since 2001 using IS*6110* restriction fragment length polymorphism (RFLP) analysis and spacer oligonucleotide typing (spoligotyping)
  - Results of mycobacterial interspersed repetitive units (MIRU-VNTR) analysis available since 2004 through the CDC's National Genotyping Services
  - Whole genome sequencing available through the CDC since 2013
- An NYC genotype cluster is defined as two or more TB cases counted in NYC since January 1, 2001 with matching RFLP and spoligotype results
  - National clustering is based on spoligotyping and 24-loci MIRU (GENType)
  - MIRU results and data from CDC helps to differentiate and prioritize clusters
  - Majority (71%) of NYC clusters identified since 2001 are comprised of 2-3 cases

HOW IS GENOTYPING USED IN TB CONTROL?

- Identify false-positive cultures
- Identify and refute relapse/re-infection
- Identify and refute recent transmission
- Detect outbreaks
- Inform and enhance contact investigation and other TB control activities
- Identify high-priority groups for intervention
- Mechanism for better understanding TB transmission
- Help answer important research questions

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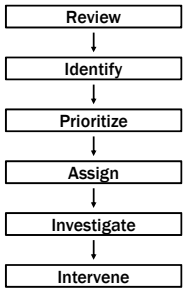
OVERVIEW: GENOTYPING DATA REVIEW AND CLUSTERING PROCESS IN NYC



DATA REVIEW AND CLUSTER IDENTIFICATION

Review → **Identify** → Prioritize → Assign → Investigate → Intervene

- Genotype results are reviewed by epidemiologists as they are received from labs
  - Considered alongside patient data and information from field and clinic staff
  - Active surveillance for outbreak strains, unexpected results
  - Identification of potential contamination and false positive isolates
  - Cases with matching RFLP and spoligotype results are clustered
  - Results and alerts from TB GIMS are reviewed and compared to existing genotype and patient data

CLUSTER REVIEW AND PRIORITIZATION

Review → Identify → **Prioritize** → Assign → Investigate → Intervene

- Clustered cases are reviewed and prioritized for investigation based on an algorithm
  - Focus is on possible recent transmission, potential for intervention
  - *High-priority*: Children, HIV-infection or other immuno-suppression, multidrug-resistant strain, healthcare worker, history of homelessness, incarceration, substance abuse
  - *Time component*: Diagnosis within 24 months of a previous case
  - *Other factors*: Country of birth, patient demographic and clinical characteristics, strains new to NYC, size of cluster, rapid cluster growth

CLUSTER ASSIGNMENT AND INVESTIGATION

Review → Identify → Prioritize → **Assign** → **Investigate** → Intervene

- Eligible cases/clusters are assigned to an epidemiologist and investigated systematically

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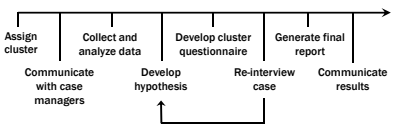
Routine cluster investigation steps, NYC:



CLUSTER ASSIGNMENT AND INVESTIGATION

Review → Identify → Prioritize → **Assign** → **Investigate** → Intervene

- Eligible cases/clusters are assigned to an epidemiologist and investigated systematically
- Extent of investigation varies depending on patient and cluster characteristics
  - Epi Review: Brief review of patient information to look for obvious links or something to prompt further action or review
  - Mini Investigation: Further review; may involve contacting case managers, gathering data not in Maven, or patient interview
  - Full investigation: Collect data, contact case managers, interview cases with cluster-specific questionnaires, create maps or other relevant data collection/visualization tools, communicate results

DETERMINING WHEN TO INITIATE PUBLIC HEALTH ACTION

Review → Identify → Prioritize → Assign → Investigate → **Intervene**

- Is there reason to suspect false-positive lab results?
- Are there newly-identified contacts or exposure sites?
- Is there evidence of recent transmission?
  - Does the cluster include children under age 5?
  - Do cases in the cluster have evidence of recent infection (e.g., TB test conversions)?
  - Were strong epidemiologic links identified between recently-identified cases?
  - Is it a newly identified genotype in NYC?

DETERMINING WHEN TO INITIATE PUBLIC HEALTH ACTION

- Was an opportunity or need to improve routine TB control activities identified?
- Is there potential for rapid cluster growth?
  - Exposure in congregate setting(s) or healthcare facilities
  - Patient clinical characteristics suggestive of infectiousness
  - Patient social characteristics suggestive of high-risk settings/contacts
  - Contact characteristics suggestive of high risk for infection or progression
  - Incomplete/difficult contact investigations

OUTBREAK INVESTIGATION AND RESPONSE OBJECTIVES

- Quickly identify outbreak-associated cases
- Ensure treatment completion among cases
- Ensure thorough and complete contact investigations
- Identify and interrupt transmission
- Ensure prompt TB evaluation and diagnosis
  - Healthcare providers
  - High-risk individuals and affected communit(ies)
- Identify mechanisms to prevent future outbreaks

OUTBREAK INVESTIGATION AND RESPONSE OBJECTIVES

- Quickly identify outbreak-associated cases
  - Create an outbreak case definition
    - Genotype(s)
    - Patient characteristics
    - Geography
    - Exposure site(s)
    - Time frame
  - Enhance surveillance for outbreak strain(s), patient characteristics
    - Generate reports and/or watch lists (Maven, TBGIMS)
    - Engage clinic, field staff and community healthcare providers
    - National genotype surveillance and interjurisdictional collaboration
    - Consider/implement active case-finding

OUTBREAK INVESTIGATION AND RESPONSE OBJECTIVES

- Quickly identify outbreak-associated cases
- Ensure treatment completion
  - Identify and address barriers to treatment adherence
  - Implement DOT (video DOT)
  - Identify/engage potential partners to facilitate treatment, locate lost patients (e.g. shelters, schools, community orgs.)
  - Consider incentives
  - Last resort: legal interventions

OUTBREAK INVESTIGATION AND RESPONSE OBJECTIVES

- Quickly identify outbreak-associated cases
- Ensure treatment completion
- Ensure thorough and complete contact investigations
  - Create data management system for contacts
  - Utilize public records and other databases (e.g. vital statistics, incarceration history, homeless history, social service utilization) and social media (e.g. Facebook, LinkedIn)
  - Re-interview cases and contacts
  - Facilitate evaluation of contacts
    - Field testing, extended clinic hours, local healthcare providers
    - Consider DOT, 3HP for LTBI treatment
    - Consider incentives

OUTBREAK INVESTIGATION AND RESPONSE OBJECTIVES

- Quickly identify outbreak-associated cases
- Ensure treatment completion
- Ensure thorough and complete contact investigations
- Identify and interrupt transmission
  - Conduct field visits
  - Re-interview patients (cases and contacts)
  - Consider photo/name recognition with patient permission
  - Conduct/expand contact investigations at exposure sites
  - Conduct targeted testing as needed
  - Assess/improve infection control practices
  - Consider environmental assessment/environmental controls

OUTBREAK INVESTIGATION AND RESPONSE OBJECTIVES

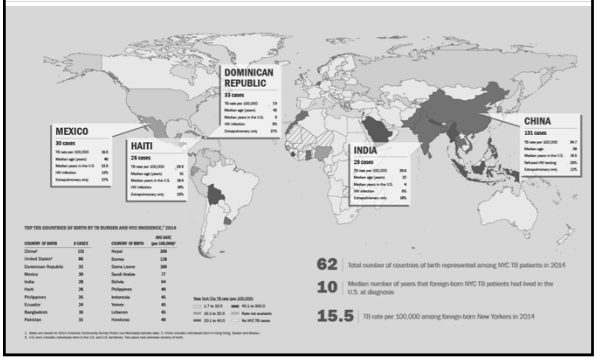
- Quickly identify outbreak-associated cases
- Ensure treatment completion
- Ensure thorough and complete contact investigations
- Identify and interrupt transmission
- Ensure prompt TB evaluation and diagnosis
  - Identify and engage local healthcare providers
    - Develop and disseminate educational resources (e.g. provider alerts)
  - Increase awareness of TB and enhance healthcare access among affected community members and the public
    - Identify barriers and enablers
    - Utilize local media outlets, digital/social media, print materials, community organizations, elected officials, word-of-mouth

OUTBREAK INVESTIGATION AND RESPONSE OBJECTIVES

- Quickly identify outbreak-associated cases
- Ensure treatment completion
- Ensure thorough and complete contact investigations
- Identify and interrupt transmission
- Ensure prompt TB evaluation and diagnosis
- Identify mechanisms to prevent future outbreaks
  - Policy and procedure changes
  - Training/education needs
  - Relationships with newly identified stakeholders
  - Opportunity/need to improve healthcare access
  - Ongoing collaboration with internal and external partners

TB OUTBREAK INVESTIGATION AND RESPONSE IN SUNSET PARK BROOKLYN, 2014-2015

TUBERCULOSIS CASES AND RATES[1] BY COUNTRY OF BIRTH,[2-3] NEW YORK CITY, 2014



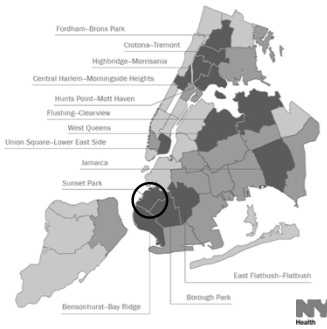
TOP TEN COUNTRIES OF BIRTH BY TUBERCULOSIS BURDEN AND INCIDENCE,[1] NEW YORK CITY, 2014

COUNTRY OF BIRTH	# CASES	COUNTRY OF BIRTH	NYC RATE (per 100,000)[1]
China[2]	131	Nepal	300
United States[3]	86	Burma	128
Dominican Republic	33	Sierra Leone	100
Mexico	30	Saudi Arabia	77
India	28	Bolivia	64
Haiti	26	Philippines	49
Philippines	25	Indonesia	45
Ecuador	24	Yemen	45
Bangladesh	16	Lebanon	45
Pakistan	15	Honduras	40

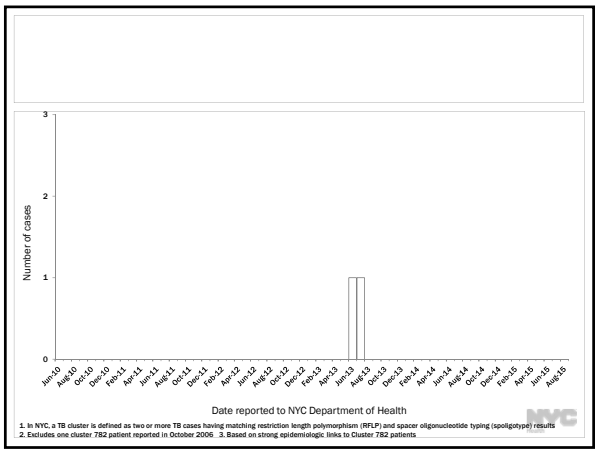
1. Rates are based on 2013 American Community Survey Public Use Microdata Sample data. 2. China includes individuals born in Hong Kong, Taiwan and Macao. 3. U.S.-born includes individuals born in the U.S. and U.S. territories. Two cases had unknown country of birth.

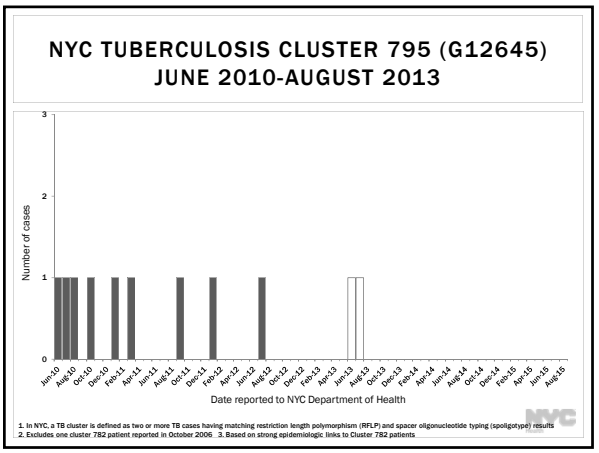
TUBERCULOSIS RATES[1] BY UNITED HOSPITAL FUND NEIGHBORHOOD, NEW YORK CITY, 2014

- Sunset Park had the highest TB rate of all UHF neighborhoods in 2014 (23.1 per 100,000)
  - More than three times higher than citywide TB rate



1. Rates are based on NYC DOHMH population estimates, modified from U.S. Census Bureau interpolated intercensal population estimates, 2000-2013. Updated August 2014.


Number of cases
Date reported to NYC Department of Health
1. In NYC, a TB cluster is defined as two or more TB cases having matching restriction length polymorphism (RFLP) and spacer oligonucleotide typing (spoligotype) results
2. Excludes one cluster 782 patient reported in October 2006 3. Based on strong epidemiologic links to Cluster 782 patients


NYC TUBERCULOSIS CLUSTER 795 (G12645)
JUNE 2010-AUGUST 2013
Number of cases
Date reported to NYC Department of Health
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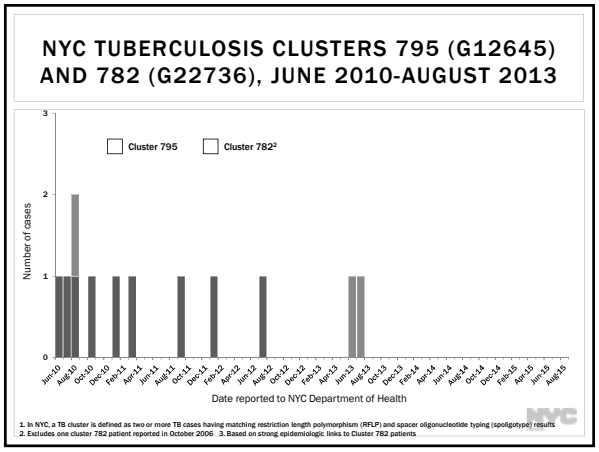
NYC TUBERCULOSIS CLUSTERS 795 (G12645)
AND 782 (G22736), JUNE 2010-AUGUST 2013
Cluster 795
Cluster 782²
Number of cases
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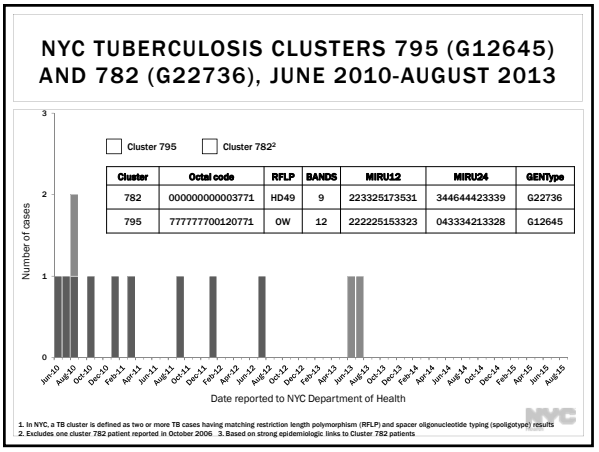
NYC TUBERCULOSIS CLUSTERS 795 (G12645)
AND 782 (G22736), JUNE 2010-AUGUST 2013
Cluster 795
Cluster 782²
Cluster | Octal code | RFLP | BANDS | MIRU12 | MIRU24 | GENType
782 | 000000000003771 | HD49 | 9 | 223325173531 | 344644423339 | G22736
795 | 777777700120771 | 0W | 12 | 222225153323 | 043334213328 | G12645
Number of cases
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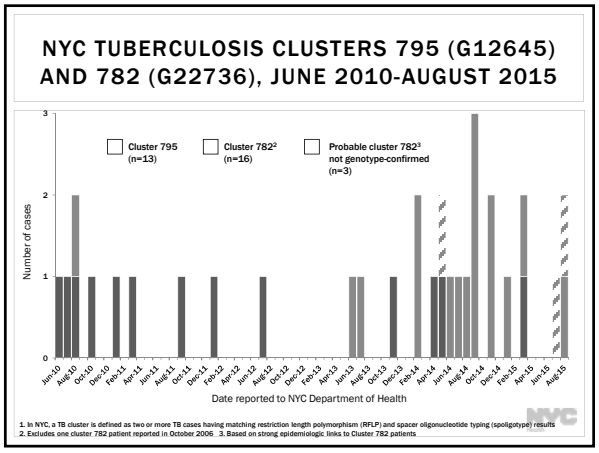
NYC TUBERCULOSIS CLUSTERS 795 (G12645)
AND 782 (G22736), JUNE 2010-AUGUST 2015
Cluster 795 (n=13)
Cluster 782² (n=16)
Probable cluster 782³ not genotype-confirmed (n=3)
Number of cases
Date reported to NYC Department of Health
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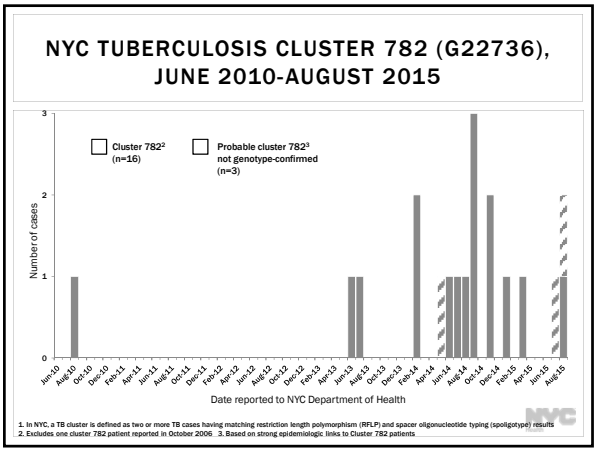
NYC TUBERCULOSIS CLUSTER 782 (G22736),
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Cluster 782² (n=16)
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PATIENT CHARACTERISTICS, CLUSTER 782 (N=17)

Patient characteristics	
Male (%)	88
Born in China (%)	94
Median age (range)	24 (19-37)
Median years in the US at diagnosis (range)	10 (2-23)
Pulmonary disease site (%)	100
Cavities on chest radiograph (%)	18
Positive sputum smear for acid-fact bacilli (%)	47

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Linked to same Brooklyn neighborhood (%)	100

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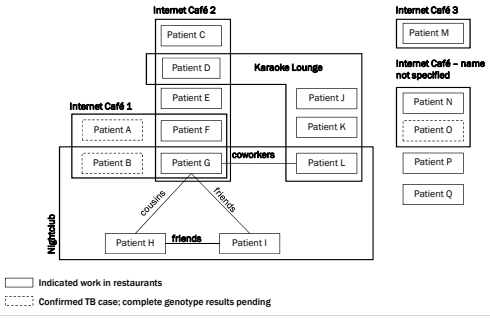
Pulmonary disease site (%)	100
Cavities on chest radiograph (%)	18
Positive sputum smear for acid-fact bacilli (%)	47
Linked to same Brooklyn neighborhood (%)	100
History of work in restaurants (%)	71
History of internet café use (%)	71
History of visiting nightclub/karaoke lounge (%)	41
History of illegal drug use (%)	24

SOCIAL CHARACTERISTICS AND POSSIBLE SITES OF TRANSMISSION, CLUSTER 782

- Internet cafes and karaoke bars (71%)
  - Small crowded spaces with little ventilation
  - Patients reported many hours per visit, several visits per week
  - Difficult to identify exposed individuals (customers)
  - Confusion over site names, locations (rapid turnover)
  - Possibility of illegal activity
  - 8 sites identified; 4 linked to four or more outbreak patients
- Out-of-state restaurant work (71%)
  - Little locating information provided by patients
  - Long work hours; sleeping/shelter on-site or nearby via management
  - Transportation via bus/van over many hours
  - Unknown/unnamed contacts
  - Locations named by patients: NJ, IL, PA, NYS, FL, MA, CT, Washington DC, OH, VA, MS, GA, VT

KNOWN EXPOSURE SITES AND EPIDEMIOLOGIC LINKS, CLUSTER 782



CONTACT INVESTIGATION

- Contact investigations
  - Household, family and social contacts and known exposure sites
  - 79 contacts identified for 17 outbreak-associated patients
    - 26 (33%) congregate settings (e.g. workplace); 37 (47%) household; 16 (20%) leisure
    - 52 (66%) tested; 27 (52%) had a newly positive test results; 16 (59%) initiated tLTBI
- Challenges
  - Difficult to identify exposed individuals
  - Fear/distrust of Health Department (among patients, contacts, business owners, community members)
  - Barriers to accessing Health Department clinic services (e.g. work hours, geographic proximity, fear/distrust, perception of cost)
  - Language/cultural barriers

HIGH-PRIORITY SUB-GROUP IDENTIFIED WITHIN CHINESE POPULATION IN NYC

- Young, geographically concentrated, transient
- Strong evidence of recent transmission
- Not recently-arrived in the US
- Delays/lack of healthcare-seeking
  - No regular source of care
  - Long work hours
  - Fear/distrust of authority/healthcare system/DOH
- Non-traditional exposure sites
- Social isolation/social networks
- Need for tailored risk communication

COMPARING CLUSTER 782 CASES TO OTHER CASES IN SUNSET PARK

Characteristics	Cluster 782 cases (n=17)
Male (%)	88
Born in China (%)	94
Median age (range)	24 (19-37)
Median years in the US at diagnosis (range)	10 (2-23)
Pulmonary disease site (%)	100
Cavities on chest radiograph (%)	18
Positive sputum smear for acid-fact bacilli (%)	47
History of work in restaurants[2] (%)	71
History of internet café use[2] (%)	71
History of visiting nightclub/karaoke[2] (%)	41
History of illegal drug use[2] (%)	24

1. Among cases counted from 2013-2015, excludes Cluster 782 cases
2. Data incomplete for non-outbreak related cases

COMPARING CLUSTER 782 CASES TO OTHER CASES IN SUNSET PARK

Characteristics	Cluster 782 cases (n=17)	Chinese Sunset Park cases[1] under age 40 (n=23)
Male (%)	88	61
Born in China (%)	94	100
Median age (range)	24 (19-37)	28 (19-36)
Median years in the US at diagnosis (range)	10 (2-23)	4 (0-23)
Pulmonary disease site (%)	100	70
Cavities on chest radiograph (%)	18	19
Positive sputum smear for acid-fact bacilli (%)	47	30
History of work in restaurants[2] (%)	71	22
History of internet café use[2] (%)	71	unk
History of visiting nightclub/karaoke[2] (%)	41	unk
History of illegal drug use[2] (%)	24	4

1. Among cases counted from 2013-2015, excludes Cluster 782 cases
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COMPARING CLUSTER 782 CASES TO OTHER CASES IN SUNSET PARK

Characteristics	Cluster 782 cases (n=17)	Chinese Sunset Park cases[1] under age 40 (n=23)	Chinese Sunset Park cases[1] (n=54)
Male (%)	88	61	65
Born in China (%)	94	100	100
Median age (range)	24 (19-37)	28 (19-36)	47 (19-91)
Median years in the US at diagnosis (range)	10 (2-23)	4 (0-23)	8 (0-42)
Pulmonary disease site (%)	100	70	83
Cavities on chest radiograph (%)	18	19	9
Positive sputum smear for acid-fact bacilli (%)	47	30	35
History of work in restaurants[2] (%)	71	22	10
History of internet café use[2] (%)	71	unk	unk
History of visiting nightclub/karaoke[2] (%)	41	unk	Unk
History of illegal drug use[2] (%)	24	4	4

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COMPARING CLUSTER 782 CASES TO OTHER CASES IN SUNSET PARK

Characteristics	Cluster 782 cases (n=17)	Chinese Sunset Park cases[1] under age 40 (n=23)	Chinese Sunset Park cases[1] (n=54)	Sunset Park cases[1] (n=78)
Male (%)	88	61	65	69
Born in China (%)	94	100	100	69
Median age (range)	24 (19-37)	28 (19-36)	47 (19-91)	44 (5-91)
Median years in the US at diagnosis (range)	10 (2-23)	4 (0-23)	8 (0-42)	9 (0-48)
Pulmonary disease site (%)	100	70	83	81
Cavities on chest radiograph (%)	18	19	9	17
Positive sputum smear for acid-fact bacilli (%)	47	30	35	38
History of work in restaurants[2] (%)	71	22	10	9
History of internet café use[2] (%)	71	unk	unk	unk
History of visiting nightclub/karaoke[2] (%)	41	unk	Unk	unk
History of illegal drug use[2] (%)	24	4	4	5

1. Among cases counted from 2013-2015, excludes Cluster 782 cases
2. Data incomplete for non-outbreak related cases

OUTBREAK RESPONSE OBJECTIVES

- Quickly identify outbreak-associated patients
- Encourage prompt TB diagnosis, reporting, referral and screening among healthcare providers
- Identify and interrupt transmission
- Identify and evaluate exposed individuals (contacts)
- Increase awareness of TB and TB-related services among community members
- Promote prompt care-seeking among individuals with TB symptoms and TB testing/evaluation among potentially-exposed individuals
- **Engage and involve community and other stakeholders**

ENGAGE AND INVOLVE STAKEHOLDERS

- Local healthcare providers
  - Physicians, nurses, social workers, medical students, others
  - Hospitals/clinics/private practice
  - Medical associations
- Community organizations
- Local businesses
- Elected officials
- Local media/press
- Researchers
- Patients
- NYC Health Department clinic and field staff

QUICKLY IDENTIFY OUTBREAK-ASSOCIATED PATIENTS

- Enhanced surveillance
  - Surveillance reports (Maven)
  - Key role of NYC Health Department field and clinic staff
- Engage local hospitals and community healthcare providers
  - Identified via provider history for outbreak patients/contacts; local healthcare provider organizations
- National genotype surveillance and collaboration across jurisdictions
  - TB GIMS
  - Interstate communication; cluster alert

ENCOURAGE PROMPT TB DIAGNOSIS, REPORTING, REFERRAL AND SCREENING

- Phone calls, presentations, meetings between BTBC staff and local healthcare providers

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  - Healthcare provider alerts

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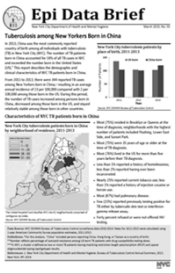
  - NYC Epi Data Brief


Epi Data Brief

Tuberculosis among New Yorkers Born in China

ENCOURAGE PROMPT TB DIAGNOSIS, REPORTING, REFERRAL AND SCREENING

- Phone calls, presentations, meetings between BTBC staff and local healthcare providers
- Develop and disseminate healthcare provider resources
  - Healthcare provider alerts
  - NYC Epi Data Brief
  - TB Annual Report
  - TB clinical guidelines
  - Patient education materials

INCREASE AWARENESS OF TB AND TB-RELATED SERVICES AMONG COMMUNITY MEMBERS

- Local press
- Targeted social media campaign
- Development and distribution of print materials
- TB screening via community health fairs and mobile van

ENGAGE LOCAL MEDIA/PRESS OUTLETS

- Citywide provider alert as initial mechanism for reaching media
  - Citywide newspapers
  - National news outlets
- Press conferences organized through community organizations and local elected officials
  - Local television news
  - Ongoing coverage (online and print) in local and international Chinese-language newspapers
- Coverage generated interest from other community groups and media outlets

PRINT/SOCIAL MEDIA CAMPAIGN DEVELOPMENT

- Primary objectives:
  - Encourage prompt care-seeking for TB symptoms
  - Promote TB testing among potentially-exposed individuals
  - Raise awareness about Health Department and TB clinics/services
- Target audience:
  - Young adults (age 18-35); born in China; living and/or spend time in outbreak-associated neighborhood; history of work in restaurants; history of spending time in internet café and/or karaoke bars; limited health care seeking; computer-savvy
- Possible distribution mechanisms:
  - Internet cafes, karaoke bars, local businesses
  - Social media
  - Print materials (posters, flyers)
  - News media/local press

PRINT/SOCIAL MEDIA CAMPAIGN DEVELOPMENT

- One campaign with two primary messages:
  - I Got Treated/Get Treated:
    - Urgency of seeking immediate care for TB symptoms
  - I Got Tested/Get Tested:
    - Emphasis on risk (e.g. spending time in small, poorly ventilated spaces with someone who is sick with TB)
    - You should be tested for TB even if you don't feel sick
  - Both versions:
    - Health Department clinic information
    - Information that directly addresses barriers to care *(e.g. free testing and treatment; confidential; all services provided regardless of immigration status; language services available)*
    - Message that TB is a serious but preventable disease that spreads through the air

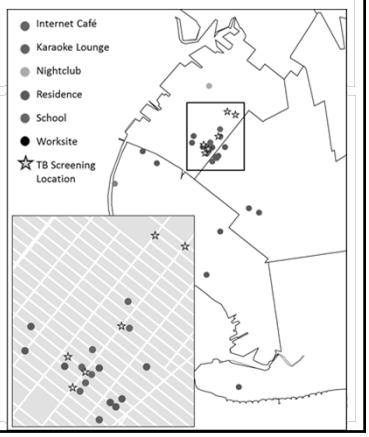
PRINT/SOCIAL MEDIA CAMPAIGN DISSEMINATION

- Posters and flyers distributed via local businesses, community organizations, street outreach
- Animated banners placed on social media sites, web browsers
  - WeChat, QQChat, Facebook
  - Geo-targeted ad placement (age, ZIP code, language)
- TB campaign page developed for NYC Health Department website
  - Campaign messaging and images
  - TB clinic locations and services
  - TB information
  - Mobile testing van locations/dates/times
  - Link via web banner ads

TARGETED TB TESTING IN OUTBREAK-ASSOCIATED NEIGHBORHOOD

- TB testing using QuantiFERON TB Gold In-Tube (QFT-GIT) was offered at community health events and via mobile van in outbreak-associated neighborhood
  - Co-sponsored by local politicians, community organizations
  - Chinese-speaking Health Department staff and community volunteers
  - Recruitment via print materials distributed by neighborhood businesses; social media; local press; street outreach
  - Surveys conducted to assess utilization by target population

MAP



OUTCOMES OF COMMUNITY SCREENING

- 181 individuals were tested using QFT-GIT during three community health events
  - 42 (23%) had positive TB test results and were referred for follow-up medical evaluation
- 168 individuals were tested using QFT-GIT during six mobile van sessions in outbreak-associated neighborhood
  - 36 (21%) had positive TB test results
    - Referred for chest radiograph and follow-up medical evaluation to Health Department TB clinic or private provider
    - 2 had suspected TB disease
    - Follow-up ongoing at Health Department TB clinic
  - 14 were known contacts to outbreak-associated patients
    - 5 (36%) had positive TB test results and were referred for chest radiograph and follow-up medical evaluation to Health

CHARACTERISTICS OF INDIVIDUALS TESTED ON MOBILE VANS (N=168)

- Born in China: 135 (80%)
- Median age: 42 (range: 5-83)
- History of internet café use: 19 (11%)
- History of night club use: 10 (6%)
- History of karaoke bar use: 29 (17%)
- History of out-of-state restaurant work: 20 (12%)
- Named/indicated spending time at a known outbreak-associated exposure site: 20 (12%)

NEXT STEPS

- Develop a mechanism for using incentives to enhance contact elicitation/evaluation/treatment
- Formalize a task force for TB outbreak response/ community outreach in the Chinese community in NYC
- Conduct formal evaluation of outbreak response/outreach activities
- Utilize mobile van for on-site testing at known exposure sites and in high-priority neighborhoods
- Expand outreach efforts to other high-risk communities

CONCLUSIONS

CONCLUSIONS (I)

- Strong epidemiologic links and similar socio-demographic characteristics among patients with the same TB strain indicate recent TB transmission in NYC
- Non-traditional exposure sites and barriers to health care-seeking among patients have challenged routine TB control activities, including prompt diagnosis and contact identification/evaluation
- Engaging local stakeholders is crucial to outbreak response activities.

CONCLUSIONS (II)

- Molecular epi data can inform public health action
  - To improve routine TB control practices
  - To identify and interrupt recent TB transmission
  - To improve healthcare access
- Commonalities among groups identified through outbreak detection and investigation
  - Marginalized groups
  - Limited access to care
  - Strong social networks
  - Suggests need for enhancing routine TB control activities
- Primary goal: outbreak ***prevention***

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