

### Cost-Benefit Analysis of Chest X-ray Screening in Specific Populations

Yun-Tsan Liao\*, Jen-Hao Cheng, Chien-Ban Hsu, Yen-Fang Huang, Chang-Hsun Chen

#### Abstract

The target populations of Taiwan CDC chest X-ray (CXR) screening program varied over the past decade. In this article, costs and benefits of CXR screening on these populations were analyzed, including people in mountainous districts and economically disadvantaged people.

Cost-benefit analysis of CXR screening was done by comparison of screening list from local health bureaus during 2011-2012 to list of nationwide tuberculosis (TB) cases detected in 2012 by active case finding in mountainous districts and economically disadvantaged people, respectively.

TB case detection rates were similar in both years among mountainous people and not related to CXR examination in previous year, both exceeded 4-times than the national rate (previous examination status unknown, 289.4/100,000; previously unexamined, 230.8/100,000; and previously examined, 248.6/100,000). TB detection rate from CXR screening in disadvantaged people during 2010-2012 was 2X higher than national average (91.0/100,000 in 2010; 205.7/100,000 in 2011 and 113.2/100,000 in 2012).

CXR screening strategy was proven to be very successful and cost-effective in active case finding among either mountainous or economically disadvantaged people, and should be continuously endorsed by Taiwan CDC to reduce the burden of TB in these high-risk populations.

**Keywords:** tuberculosis ; chest X-ray screening ; target population ; mountainous district ; economically disadvantaged people

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## The Effectiveness of Chest Radiographic Screening Among Tuberculosis Contacts

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### Abstract

For decades, the most important strategy in tuberculosis (TB) control in Taiwan is to find case early and provide treatment to patient in a timely manner. In order to detect a case in a timely way, finding active TB cases amongst populations with poor access to medical care has been found to be especially important. Due to the implementation of various strategies, the number of infectious TB patients in Taiwan has decreased yearly, in a gradual fashion. The strategy of active case finding (ACF) has been adjusted step by step. Review from literature, an enhanced ACF effort for a TB contact is the best way to decrease the persistent transmission of TB from both an empirical and cost-benefit point of view. Our study enrolled the contacts of TB patients diagnosed from April 1, 2008 to December 31, 2012. Every contact had at least completed an initial chest radiograph (CXR) for the purpose of contact tracing. The rate of newly developed TB among contacts was further analyzed with stratifications of infectious TB index patients and birth cohorts of contacts. The effectiveness of both first and 12th month CXR screening was evaluated respectively. The results showed that the first CXR screening among contacts was helpful for ACF. The detection rate of TB after the first CXR performed on the contacts, whose index TB patient had extra-pulmonary TB without lung involvement, was found to be low enough that CXR service could be suspended for this target population if radiographic resources were strained at some point in the future. However, contact screening for target population younger than 5 years was still essential. As to the 12th month CXR among contacts, the detection rate was acceptable only when index TB patients were smear-positive and culture confirmed as *Mycobacterium tuberculosis*. For contacts whose index TB patients were classified as infectious, those who took 12th month CXR examination could be diagnosed 2 months earlier compared with those who did not complete 12th month CXR examination.

**Keywords:** effectiveness of chest radiograph ; TB contacts ; active case finding

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## A Pulmonary Tuberculosis Cluster in An Institution in Southern Taiwan, 2012

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### Abstract

A mental institution resident in Southern Taiwan was ill and sought medical service in March 2014; later was confirmed as pulmonary tuberculosis (TB). Two contacts were found having abnormal chest radiography at the twelfth month and were notified. In July 2013, there were six reported probable patients with pulmonary tuberculosis from the institution including the index case. Five of them were confirmed, and one was excluded. Restriction fragment length polymorphism (RFLP) molecular study done at the Research and Diagnostic Center of Taiwan CDC revealed that the five isolates belonged to the same subtype, thus, proved this cluster of patients with pulmonary tuberculosis.

After two serial meetings with TB specialists, not only chest radiographies of related contacts were followed, but also extended the immunoassay from the previous existing tuberculin skin test (TST) to both interferon-gamma release assay (IGRA; QuantiFERON-TB, QFT) and TST for those identified contacts. After evaluation by physicians, the contacts who had both positive results of TST and IGRA were undergone latent tuberculosis infection (LTBI) treatment.

Besides, we suggested the administrator keeping the confirmed TB patients in the isolation room on the first floor until his/her sputum was negative for acid-fast stain or TB culture, and also to isolate those suspected TB patients.

Of total 85 contacted people, the positive rate of TST was 77.6% (66/85), the positive rate of QFT was 29.5% (18/61), and the positive rate for both TST and QFT was 21.2% (18/85). Twenty-four people underwent LTBI treatment, of whom 22 people completed the treatment course, and 2 people discontinued due to the adverse effects. There was not any tuberculosis patient found in the institution by October 2014.

**Keywords:** Tuberculosis ; Populous institutions ; Cluster infection ; Contact ; Treatment for latent tuberculosis infection (LTBI)

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Weekly Data of Notifiable Infectious Diseases ( by week of diagnosis )

Classification	Disease Diagnosed <sup>1</sup>	Case diagnosis week		Week 9		Week 1—9	
		2015	2014	2015	2014	2015	2014
Category I	Plague	0	0	0	0	0	0
	Rabies	0	0	0	0	0	0
	SARS	0	0	0	0	0	0
	Smallpox	0	0	0	0	0	0
Category II	Acute Flaccid Paralysis	0	0	3	6	18	30
	Acute Viral Hepatitis type A	1	1	54	34	0	0
	Amoebiasis	7	4	0	0	1	2
	Anthrax	0	0	0	0	0	0
	Chikungunya Fever	0	0	1	2	0	0
	Cholera	0	0	0	0	141	87
	Dengue Fever	5	1	0	4	0	0
	Dengue Hemorrhagic Fever/Dengue Shock Syndrome	0	0	0	0	0	0
	Diphtheria	0	0	0	0	0	0
	Enterohemorrhagic E. coli Infection	0	0	0	0	0	0
	Epidemic Typhus Fever	0	0	0	0	0	0
	Hantavirus Pulmonary Syndrome	0	0	0	0	0	0
	Hemorrhagic Fever with Renal Syndrome	0	0	0	1	0	1
	Malaria	0	0	2	3	0	0
	Measles	0	0	0	4	1	2
	Meningococcal Meningitis	1	0	1	2	0	0
	Paratyphoid Fever	0	0	1	2	0	0
	Poliomyelitis	0	0	0	0	0	0
	Rubella	0	1	1	1	48	29
	Shigellosis	7	4	7	7	0	0
Typhoid fever	3	1	0	0	0	0	
West Nile Fever	0	0	0	0	21	13	
Category III	Acute Viral Hepatitis type B	2	3	31	4	0	0
	Acute Viral Hepatitis type C <sup>3</sup>	0	0	0	0	1	3
	Acute Viral Hepatitis type D	0	0	0	0	0	1
	Acute Viral Hepatitis type E	0	0	0	0	0	0
	Acute Viral Hepatitis untype	0	0	0	0	1	1
	Congenital Rubella Syndrome	0	0	0	0	1	0
	Enteroviruses Infection with Severe Complications	0	0	1	1	0	0
	Haemophilus Influenza type b Infection	0	0	1	0	0	0
	Japanese Encephalitis	0	0	0	0	30	27
	Legionellosis	2	1	109	113	0	0
	Mumps <sup>4</sup>	12	5	0	0	23	3
	Neonatal Tetanus	0	0	1	0	0	0
	Pertussis	1	0	0	0	0	0
	Tetanus <sup>2</sup>	0	0	0	0	0	0
Category IV	Botulism	0	0	1	0	0	0
	Brucellosis	0	0	0	0	0	0
	Complicated Influenza	25	122	129	962	0	0
	Complicated Varicella <sup>4</sup>	6	0	16	20	0	0
	Endemic Typhus Fever	0	0	0	4	0	0
	Herpesvirus B Infection	0	0	0	0	0	0
	Invasive Pneumococcal Disease	15	6	145	175	0	0
	Leptospirosis	1	0	9	9	0	0
	Lyme Disease	0	0	0	0	3	4
	Melioidosis	0	0	0	0	4	16
	Q Fever	1	2	4	16	0	0
	Scrub Typhus	2	3	51	68	0	1
	Toxoplasmosis	0	0	0	1	0	0
Tularremia	0	0	0	0	0	0	
Category V	Ebola Virus Disease	0	0	0	0	0	0
	Ebola-Marburg Hemorrhagic Fever	0	0	0	0	0	0
	Novel Influenza A Virus Infections <sup>5</sup>	0	0	0	0	0	0
	Lassa Fever	0	0	0	0	0	0
	Rift Valley Fever	0	0	0	0	0	0
	Middle East Respiratory Syndrome Coronavirus	0	0	0	0	0	0
Yellow Fever	0	0	0	0	0	0	

1. The following 8 chronic diseases are excluded from the table: MDR-TB, Tuberculosis, Syphilis, Gonorrhoea, HIV Infection, AIDS, Hansen Disease and Creutzfeldt-Jakob Disease.  
 2. Reported cases.  
 3. The epidemiological week calendar established by the World Health Organization is adopted for calculating each week's cumulative total.  
 4. Since 2014/1/1, "Varicella" was modified to "Complicated Varicella".  
 5. Since 2014/3/6, the case definition for confirmed Acute hepatitis C was changed from "meet the clinical and laboratory conditions" to "meet the clinical or laboratory conditions".  
 6. Since 2014/7/1, various subtypes of human cases of avian influenza changed to the fifth class of infectious diseases "novel influenza A virus infections". The original "H5N1 flu" and "H7N9 flu" were removed on the same day.

## Suspected Clusters

- Nineteen clusters were reported, including 3 tuberculosis clusters, 9 diarrhea clusters, 4 upper respiratory tract infection clusters, 1 influenza-like illness cluster, 1 varicella cluster and 1 fever of unknown origin cluster.

## Imported Infectious Diseases

- 13 confirmed cases were imported from 7 countries during week 9 of 2015.

Country Disease	Indonesia	Brazil	Vietnam	Philippines	Japan	Bangladesh	Cambodia	Total
Dengue Fever	4	2	1					7
Amoebiasis	1			1				2
Shigellosis	1						1	2
Typhoid fever						1		1
Scrub Typhus					1			1
<b>Total</b>	6	2	1	1	1	1	1	13

Note: The statistics listed in this table include imported cases that were either confirmed or updated<sup>\*</sup> in the previous week.

- A total of 115 confirmed cases were imported from 22 countries in 2015.
- Top 3 imported diseases : Dengue fever (40), Amoebiasis (32), Shigellosis (18).
- Top 3 countries responsible for most imported cases : Indonesia (65), Vietnam (9), Malaysia (5).

## Summary of Epidemic

- **Influenza** : Although the epidemic has begun to reverse, the influenza activity still remained high. Since January 1, 2015, a total number of 128 cases of severe complicated influenza have been confirmed, including 14 cases infected by H1N1, 99 cases infected by H3N2, 3 cases infected by untyped influenza A and 12 cases infected by influenza B. Among these cases, 16 deaths were caused by infection with H3N2 and 1 death was caused by infection with influenza B. During week 9, H3N2 is the dominant strain circulating in the community.
- **Diarrhea** : Although the number of patient visits for viral gastroenteritis declined as compared to the week before, the outbreak remained elevated. In addition, many diarrhea clusters had occurred recently. The public is urged to practice good personal hygiene. More particularly, the food and beverage industry, hospitals, care facilities, schools and other densely populated places are urged to strengthen infection prevention and control measures. Individuals experiencing any suspicious symptoms are advised to seek immediate medical treatment and stay home to prevent further transmission of the disease.

## Weekly Data of Notifiable Infectious Diseases (by week of diagnosis)

Case diagnosis week		Week 10		Week 1—10	
Classification	Disease Diagnosed <sup>1</sup>	2015	2014	2015	2014
Category I	Plague	0	0	0	0
	Rabies	0	0	0	0
	SARS	0	0	0	0
	Smallpox	0	0	0	0
Category II	Acute Flaccid Paralysis	0	0	3	6
	Acute Viral Hepatitis type A	0	1	18	31
	Amoebiasis	8	8	62	42
	Anthrax	0	0	0	0
	Chikungunya Fever	0	0	1	2
	Cholera	0	0	0	0
	Dengue Fever	13	4	154	91
	Dengue Hemorrhagic Fever/Dengue Shock Syndrome	0	0	0	4
	Diphtheria	0	0	0	0
	Enterohemorrhagic E. coli Infection	0	0	0	0
	Epidemic Typhus Fever	0	0	0	0
	Hantavirus Pulmonary Syndrome	0	0	0	0
	Hemorrhagic Fever with Renal Syndrome	0	0	0	1
	Malaria	0	0	2	3
	Measles	0	0	0	4
	Meningococcal Meningitis	0	0	1	2
	Paratyphoid Fever	0	0	1	2
	Poliomyelitis	0	0	0	0
	Rubella	0	0	1	1
	Shigellosis	1	1	49	30
Typhoid fever	1	0	7	7	
West Nile Fever	0	0	0	0	
Category III	Acute Viral Hepatitis type B	3	3	24	16
	Acute Viral Hepatitis type C <sup>5</sup>	1	2	32	6
	Acute Viral Hepatitis type D	0	0	0	0
	Acute Viral Hepatitis type E	0	0	1	3
	Acute Viral Hepatitis untype	0	0	0	1
	Congenital Rubella Syndrome	0	0	0	0
	Enteroviruses Infection with Severe Complications	0	0	1	1
	Haemophilus Influenza type b Infection	0	0	1	0
	Japanese Encephalitis	0	0	0	0
	Legionellosis	2	3	32	30
	Mumps <sup>2</sup>	15	15	124	128
	Neonatal Tetanus	0	0	0	0
	Pertussis	1	0	24	3
	Tetanus <sup>2</sup>	0	0	1	0
Category IV	Botulism	0	0	1	0
	Brucellosis	0	0	0	0
	Complicated Influenza	26	146	155	1108
	Complicated Varicella <sup>4</sup>	0	1	16	21
	Endemic Typhus Fever	0	0	0	4
	Herpesvirus B Infection	0	0	0	0
	Invasive Pneumococcal Disease	8	17	153	192
	Leptospirosis	0	0	9	9
	Lyme Disease	0	0	0	0
	Melioidosis	0	1	3	5
	Q Fever	0	2	4	18
	Scrub Typhus	1	1	52	69
	Toxoplasmosis	0	0	0	1
Tularremia	0	0	0	0	
Category V	Ebola Virus Disease	0	0	0	0
	Ebola-Marburg Hemorrhagic Fever	0	0	0	0
	Novel Influenza A Virus Infections <sup>6</sup>	0	0	0	0
	Lassa Fever	0	0	0	0
	Rift Valley Fever	0	0	0	0
	Middle East Respiratory Syndrome Coronavirus	0	0	0	0
Yellow Fever	0	0	0	0	

- The following 8 chronic diseases are excluded from the table: MDR-TB, Tuberculosis, Syphilis, Gonorrhoea, HIV Infection, AIDS, Hansen Disease and Creutzfeldt-Jakob Disease.
- Reported cases.
- The epidemiological week calendar established by the World Health Organization is adopted for calculating each week's cumulative total.
- Since 2014/1/1, "Varicella" was modified to "Complicated Varicella".
- Since 2014/3/6, the case definition for confirmed Acute hepatitis C was changed from "meet the clinical and laboratory conditions" to "meet the clinical or laboratory conditions".
- Since 2014/7/1, various subtypes of human cases of avian influenza are reported as "novel influenza A virus infections", a Category V Notifiable Infectious Disease. The original "H5N1 flu" and "H7N9 flu", which were respectively listed as a Category I Notifiable Infectious Disease and Category V Notifiable Infectious Disease were removed from the list on the same day.

### Suspected Clusters

- Twenty four clusters were reported, including 12 diarrhea clusters, 5 tuberculosis clusters, 4 upper respiratory tract infection clusters, 2 influenza-like illness clusters, and 1 varicella cluster.

### Imported Infectious Diseases

- 23 confirmed cases were imported from 3 countries during week 10 of 2015.

Disease \ Country	Indonesia	Philippines	Malaysia	Total
Dengue Fever	8		2	10
Amoebiasis	6	2		8
Shigellosis	4			4
Typhoid fever	1			1
<b>Total</b>	<b>19</b>	<b>2</b>	<b>2</b>	<b>23</b>

Note: The statistics listed in this table include imported cases that were either confirmed updated\* in the previous week.

- A total of 138 confirmed cases were imported from 22 countries in 2015.
- Top 3 imported diseases : Dengue fever (50), Amoebiasis (40), Shigellosis (22).
- Top 3 countries responsible for most imported cases : Indonesia (84), Vietnam (9), Malaysia (7).

### Summary of Epidemic

- **Influenza** : Although the epidemic has begun to reverse, we are still in the middle of the flu season. Since January 1, 2015, a cumulative total of 153 cases of severe complicated influenza have been confirmed, including 16 cases infected by H1N1, 120 cases infected by H3N2, 2 cases infected by untyped influenza A and 15 cases infected by influenza B. Among these cases, 19 deaths were caused by infection with H3N2 and 1 death was caused by infection with influenza B. During week 10, H3N2 is the dominant strain circulating in the community.
- **Diarrhea** : Although the number of patient visits for viral gastroenteritis decreased as during the past two weeks, viral gastroenteritis activity remained high and many diarrhea clusters had still occurred. The public is urged to practice good personal hygiene. More particularly, the food and beverage industry, hospitals, care facilities,

schools and other densely populated places are urged to strengthen infection prevention and control measures. Individuals experiencing any suspicious symptoms are advised to seek immediate medical treatment and stay home to prevent further transmission of the disease.

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