

Original Article

Review of Repatriation Measures for Foreign Laborers with Pulmonary Tuberculosis in Central Taiwan

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Abstract

According to the regulations in Taiwan, foreign laborers should be repatriated after the diagnosis of pulmonary tuberculosis (TB). The uninterrupted medical care and public health intervention for the repatriated TB patients rely on adequate international collaboration. However, the quality of international referral was rarely evaluated.

Foreign laborers with suspected pulmonary TB in central Taiwan reported between July 2009 and February 2012 were enrolled. Demographic data of the referral forms were reviewed and compared with that in the National Notifiable Diseases System (NNDS). The laboratory results, drug resistance profile and medications for TB were recorded. The smear positive rate and culture positive rate were analyzed and compared with those of pulmonary TB patients in Taiwan in 2009.

During the study period, 206 foreign laborers were diagnosed with pulmonary TB. Among the 141 cases with referral forms, 28 (19.9%) had consistent demographic records on the referral forms and NNDS. Among the 177 (85.9%) patient who had sputum studies, 23 (11.2%) were smear positive and 65 (31.6%) were culture positive. The smear positive rate and culture positive rate of foreign laborers were both significantly lower than those of pulmonary TB patients in Taiwan in 2009 ($p < 0.001$). Among the 65 culture positive cases, 5 (7.7%) had mycobacterium isolate resistant to at least one anti-TB medication. Of the 194 foreign laborers who had been repatriated, 57 (29.4%) had been treated with anti-TB drugs for at least 14 days.

The inconsistency of demographic data between referral form and NNDS might lead to difficulties in international collaboration. Inadequate anti-TB treatment before repatriation might result in unexpected exposure to TB among other passengers.

Keywords: foreign labor, pulmonary tuberculosis

Introduction

Tuberculosis (TB) has been one major threat to human health ever since *Mycobacterium tuberculosis* found by German microbiologist Robert Koch [1]. Although the number of TB patients has started to decline since 2006 as reported by the World Health organization (WHO), globally, there were still around 8.8 million people infected in 2010; among them, 1.1 million died because of TB without association with HIV infection and 350 thousand died with concomitant HIV infection [2]. In Taiwan, a campaign aiming to half TB patients in 10 years was launched in 2006. To reduce the damage of TB to our citizens' health, many resources have been used and lots of efforts have been made by health care professionals and public health workers. As a result, both the incidence and the mortality of TB declined significantly [3].

Foreign laborers have been recruited to Taiwan for years, considering the social and economic needs. According to current regulations, health check-up including chest radiography to rule out pulmonary TB is mandatory for foreign laborers 3 days after entry, and 6-, 18-, and 30 months after initiation of their work in Taiwan. Health examination needs to be done within 30 days before or after the designated date [4]. Foreign laborers with health problems would be repatriated back to their home countries. For those with suspect pulmonary TB, they would first be referred to a secondary medical facility. If pulmonary TB is confirmed, the employment would be suspended and the patient would be repatriated. According to the new manual of tuberculosis control revised in March 2011, transnational referral is required when Taiwanese patients relocate to other countries or alien patients move back to their home countries, so that a better disease control can be achieved and an effective treatment in TB patients can be continued [5].

Because the initial symptoms of TB are vague and non-specific, and the disease progression is slow, we usually rely on chest radiography and sputum acid-fast smear to screen and make tentative diagnosis. We still need culture results or other serologic or molecular biological studies in making definitive diagnosis. These confirmative studies usually take longer time; some of them take more than a month but still cannot provide sufficient evidence to verify a TB infection. Clinicians sometimes will have therapeutic trial and establish a diagnosis based on patients' clinical responses to the anti-TB drugs.

To ensure citizens' health, repatriation of foreign laborers with suspected pulmonary TB is sometimes a race against time and decisions need to be made as soon as possible. Clinicians will have to balance between a prompt diagnosis and a possible compromise of foreign labor's right to work. In addition, sufficient anti-TB treatment before repatriation is an important issue in control the disease from spreading. It can prevent other passengers from exposure to pulmonary TB. In this article, we reviewed the data of foreign laborers with suspect pulmonary TB collected in central Taiwan and analyzed the aforementioned topics.

Materials and Methods

Data of foreign TB patients reported to the NNDS between July 2009 and February 2012 was screened. Information from those who were reported in central Taiwan (including Taichung City, Changhua County, and Nantou County) and were foreign laborers was downloaded on July 10, 2012. Nationality, gender, age, results of sputum studies, drug susceptibility test of isolated mycobacterium, drug administration records before repatriation were recorded and use descriptive epidemiology to analyze.

Foreign laborers were classified into four categories according to their occupation or major workplace documented in the system. Those who worked for companies, factories or construction sites were classified as industrial and business workers. Those who worked as domestic servant were classified as household workers. Those who worked in health care facilities or respiratory care centers were classified as health care workers. Those who did not fill in their occupation were marked as occupation unknown. The duration of treatment before repatriation was defined as the duration from the date of drug prescription to the date of repatriation, unless the days of prescription were shorter than that. In the later case, the days of prescription were used instead to represent the treatment duration before repatriation.

The transnational referral sheets were collected from the Third Branch and the Epidemic Intelligence Center (EIC) of Taiwan CDC. All the paper sheets were collected from the archive in the Third Branch, and the duplicate electronic files of the referral sheets were obtained from EIC, the corresponding unit of the International Health Regulation Focal Point. We compared the information regarding the foreign laborers' characteristics, anti-TB treatment, and the date of repatriation from the referral sheets (both paper and electronic versions) with the data obtained from the National Notifiable Reporting System (NNRS). Some cases could not be identified in the NNRS database because absence of correct passport numbers or names. We used the date of diagnosis as benchmark, compared the personal information, x-ray results, workplace, laboratory results, and anti-TB drugs of all the cases diagnosed within 2 months before and after that date in both systems to find the most compatible cases. The foreign laborers were then divided into four groups according to the consistency of their names and passport numbers in these two different systems (NNRS and transnational referral sheets) - those with identical names and passport numbers, those with the same names but different passport numbers, those with different names but the same passport numbers, and those with different names and passport numbers.

We used the binomial distribution to compare the acid-fast smear positive rates, culture positive rates, and proportions of chest x-ray with cavities of the repatriated foreign laborers and the newly diagnosed Taiwanese patients in 2009. The results of smear positive rates were obtained from the annual report of TB control published in 2011[6]. The results of culture positive rates and the proportions of chest x-ray with cavities were provided by EIC. All statistical analyses were done by Microsoft Excel 2010 version.

Results

Between July 2009 and February 2012, 266 foreign laborers were reported as TB patients. Among them, 38 were excluded from this study because clinicians changed the diagnosis, 22 had extra-pulmonary TB, so only the rest 206 patients were included in this study. Ranking according to their nationality, 95 (46.1%) came from Indonesia, 41 (19.9%) from Vietnam, 38 (18.4%) from Thailand, and 32 (15.5%) from the Philippines. One hundred and five patients were male (51%). Their average age was 29.8 (± 6.1). Eighty one patients (39.3%) were industrial laborers, 85 (41.3%) were household servants, 6 (2.9%) work in long term care facility, and workplace of the rest 34 (15.5%) patients were unknown (Table 1).

Among the 206 pulmonary TB patients, 177 (89.5%) had sputum studies including acid-fast smear and Mycobacterial culture. The sputum cultures were positive in 65 patients (31.6%), the proportion was significantly lower than the culture positive rate in Taiwanese patients (74.5%) ($p < 0.001$). The sputum smears were positive in 23 patients (11.2%), the proportion was significantly lower than the smear positive rate in Taiwanese patients (41.0%) ($p < 0.001$). On chest radiography, 29 patients had cavities (14.1%); the proportion was also significantly lower than that of Taiwanese patients (18%) ($p = 0.03$) (Table 2).

According to drug susceptibility tests, five of the 65 isolates (7.7%) had resistance to at least one anti-TB drug. Two had resistance to low dose streptomycin (SM), one had resistance to both high dose isoniazid (INH) and high dose SM, one had resistance to high dose INH, high dose SM, and low dose ethambutol (EMB), and one had multi-drug resistant TB (MDR). The MDR strain was resistant to low dose INH, rifampicin (RMP), EMB and rifabutin. Cavity could be identified on the chest radiograph of the MDR patient on May 31, 2011. The patient's sputum sampled between June 1 and June 3 were negative on acid-fast smear but were positive on mycobacterial culture. She was repatriated on July 16. The duration between notification and repatriation was 44 days but the duration of drug prescription was 28 days. Among the four prescribed drugs (INH, RMP, pyrazinamide [PZA], and EMB), only PZA might be effective. Her drug susceptibility test confirming her MDR

Table 1. Characteristics of foreign laborer tuberculosis patients

	Philippine (n=32)	Indonesia (n=95)	Thailand (n=38)	Vietnam (n=41)	Total (n=206)
Gender					
Male (%)	12(11.4)	25(23.8)	35(33.3)	33(31.4)	105 (100)
Female (%)	20(19.8)	70(69.3)	3(3.0)	8(7.9)	101 (100)
Average age (\pm standard deviation, SD)	30.8 \pm 5.7	28.8 \pm 4.9	35.3 \pm 6.4	26.1 \pm 4.7	29.8 \pm 6.1

Table 2. Sputum acid-fast smear and mycobacterial culture results (n=206)

	Foreign laborer	Taiwanese patients in 2009	p value
Culture positive	87(42.2%)	—	—
NTM alone*	22 (10.7%)	—	—
MTB†	65 (31.6%)	74.5%	<0.001*
Smear positive	23(11.2%)	41.0%	<0.001*
Cavity on chest radiography	29(14.1%)	18.0%	0.03

* non-tuberculous Mycobacterium (NTM)

† *Mycobacterium tuberculosis* (MTB)

status was not available until August 23, after the patient was repatriated, so the patient was not restricted from leaving our country or taking an airplane and none of the special precautions could be done in time.

Comparing the transnational referral forms from the 3rd Branch of Taiwan CDC and the electronic data from EIC, 12 patients had not been repatriated, 53 patients had no referral forms. Twenty eight cases of the remaining 141 patients (19.9%) had different passport number or name spelling in these two systems. Seven (5%) of them had different passport number but the same name spelling, while 71 of them (50.4%) had the same passport number but different spelling. Both passport number and name spelling were inconsistent in 35 cases (24.8%).

Excluding the twelve patients who had not been repatriated, 31 of the remaining 194 foreign laborers (16.0%) did not receive anti-TB treatment before repatriation, 106 were repatriated within 14 days after diagnosis (54.6%), only 57 (29.4%) had at least 14 days of treatment before repatriation. Analyzing the duration of treatment before repatriation, 16 of the 22 smear positive cases (72.7%) and 26 of the 61 culture positive cases (42.6%) were repatriated after at least 14 days of treatment (Table 3) .

Discussion

According to the WHO annual report on global TB control in 2011, all mother countries of repatriated foreign laborers were on the list of top 22 countries with highest TB incidence [2]. Especially Indonesia, with an estimation of 370 to 540 thousands total number of TB patients and an annual incidence of 189 per hundred thousand population, it is the fourth most severe country in terms of the disease burden. The annual incidence of TB in the Philippine, Vietnam, and Thailand was 275, 199, and 137 per hundred thousand population, respectively; all of them were higher than the incidence in Taiwan. A strict screening before recruit foreign laborers from these countries should be enforced, so that the TB burden in Taiwan would not increase because of the importation of foreign human resource. For those who are recruited to work as health care providers, including those who work in medical or long-term care facilities and those who take care of elder and handicapped household members, because they are taking care of relatively immune-compromised people who are more susceptible to TB infection, a strict screening test is especially important. If foreign laborers have got TB infection, they may spread the disease in their workplace. A routine health check-up before entry to our country is necessary. In addition, foreign laborers from

Table 3. The duration of anti-TB treatment before repatriation

	Smear positive patients (n=22)(%)	Culture positive patients (n=61)(%)	Total(n=194) (%)
Before repatriation			
No treatment	0	8(13.1%)	31(16.0%)
Treatment for less than 14 days	6(27.3%)	27(44.3%)	106(54.6%)
Treatment for at least 14 days	16(72.7%)	26(42.6%)	57(29.4%)

countries with higher TB incidence might have acquired latent infection in their home country, which could progress into active infection later. So even if the first screening test is negative, regular health check-ups afterward are still important.

Some foreign laborers have possessed health certificate from their own country and claimed that the regular health check-up before and after entering Taiwan should be remitted. However, there are still questions on whether the medical certificate is sufficient to prove they are qualified to work in Taiwan. In an article reviewing 3,117 Indonesian laborers with medical certificate from their own country, a health check-up in Taiwan found inconsistent results in 223 (7.25%) while 50 of them (1.6%) were found to have pulmonary TB [7]. So far, no matter a health check-up is performed before the entry or not, a thorough examination in Taiwan might still be necessary to prevent our citizens from getting TB infection. Nevertheless, the balance between human rights and prevention of TB importation should be carefully assessed.

The diagnosis of TB is always a big challenge in control the epidemic. The high expense and high technique application threshold have made polymerase-chain reaction (PCR), a novel diagnostic tool, more difficult to put into daily practice. There are also some debates on the sensitivity and specificity of the test [8]. So, conventional sputum acid-fast smear and mycobacterial culture are still the most common method used in TB diagnosis. Because both sputum studies are time-consuming and the sensitivity is not good enough, the sputum study results might not be available before the repatriation of the foreign laborers with suspect TB infection. Sometimes employers will ask to repatriate the foreign laborers with suspect TB infection before sputum samples are taken and a formal diagnosis is made, considering the risk of disease spreading and the space necessary for isolation. The repelling attitude toward the suspect cases could result in damage of foreign laborers' working rights. In our study, only 11.2% of the cases had positive sputum acid-fast smear and 31.6% had positive mycobacterial culture (MTB). Both proportions were significantly lower than the average rate in Taiwanese patients and the accuracy of TB diagnosis has always been a big issue. In addition, our study showed that the presence of cavitation on chest radiography was less common in foreign laborers, indicating that an earlier diagnosis could be made by regular health check-ups. Enrollment of non-TB patients into the denominator should also be considered as a confounding factor in calculating the proportion of patients with cavities on chest x-ray. A more accurate diagnostic tool is needed in foreign laborers' routine health check-ups, so that we would not compromise their working rights.

In our study, sputum sampling were not ordered or performed in 29 (14.1%) foreign laborers with pulmonary TB. Although positive sputum studies are not mandatory requirement in making diagnosis, they are still very useful tools. We could not identify the reasons that result in a low sampling rate, but 3% saline could be used in sputum induction for those who have difficulties in sputum expectoration.

In our manual of TB control and treatment, an international flight more than 8 hours is forbidden for pulmonary TB patients with positive sputum acid-fast smear, all international flights are not allowed in patients with MDR TB infection, and all foreign laborers with pulmonary TB need to receive a 14-days-course of anti-TB treatment under direct observation before repatriation [5]. Reviewing the literature, a 14-day of anti-TB treatment including isoniazid was very effective in decrease the mycobacterial population and infectivity [9], but only 57 of the 194 subjects (29.4%) in our study had taken at least 14 days of anti-TB drugs. Although the flight from Taiwan to most home countries of the foreign laborers is shorter than 8 hours, other passengers are still exposed unexpectedly to the pulmonary TB patient and may therefore get infection. Because local health bureaus usually were not informed the repatriation before the flights, it would be difficult for them to set up precaution or intervene. We suggest a stricter following on the recommendations in our manual. For those diagnosed as pulmonary TB, no matter the sputum acid-fast stain is positive or not, a 14-days treatment under direct observation should be given, so that the disease will not spread out when we repatriate the patients.

Sufficient anti-TB treatment before repatriation is an important issue; it could be achieved by following methods. First, try to improve the cooperation between public health departments and departments that are responsible to recruit and repatriate the foreign laborers. In the United States, illegal immigrants with TB infection had received an average 22 to 82.6 days of treatment before repatriation between 2001 and 2005. There were still cases repatriated before the beginning or completion of the initial treatment aimed to reduce their infectivity, some were reported to become drug-resistant TB patients [10-11]. The aforementioned examples emphasize the importance of interdisciplinary cooperation and comprehensive legislation. If public health departments can work with departments that are responsible to employ and repatriate the foreign laborers and employers (factories, institutes, or families), the proportion of repatriated foreign laborers with adequate anti-TB treatment could be increased. Second, try to set up shelters or dormitories for those who need treatment before repatriation. Foreign laborers usually stay in dormitories offered by their employer and always share a room with other coworkers. Once they were diagnosed as TB patients, good space for isolation and medical expenses become big problems for both the employers and foreign laborers. Public health departments can solve these problems by offering free but compulsory isolation. Third, try to eliminate the stereotypic prejudice about TB, especially for those who work in households. Employers often could not accept laborers with suspect TB lesions on chest radiography and request for repatriation even before a definite diagnosis.

In this study, we found a case with MDR TB infection whose drug resistance was identified after repatriation. So when the patient was on the flight back to her home country, she could still be infective, which was against our law, and might result in other passengers' infection. However, only 0.5% of our 206 study cases had MDR TB, the

proportion was lower than the proportions among both newly diagnosed cases and retreated cases in Taiwan in 2009, which were 1.1% and 8.2%, respectively. Conventional drug susceptibility tests usually take more than 2 months to detect the drug resistance. Because Taiwanese non-MDR TB patients without risk factors are not qualified for free rapid screening tests (genotyping), they can infect people in the same community or on the same flights due to the late identification of drug resistance. Compared with Taiwanese MDR TB patients, the risk of spreading disease is not higher in foreign laborers. In the future, we expect new diagnostic tools that can help identifying drug-resistance within days and can probably be performed at the doctor's office. The earlier the diagnosis, the less can MDR TB threaten to public's health [8,13].

In our study, we also found an inconsistency in names and passport numbers between the transnational referral forms and NNDS. The difference in passport numbers may be explained by those public health workers can either key-in passport number or alien resident certificate number in the column of identification number of the NNDS, while they can only fill passport numbers on transnational referral forms. In terms of the difference in names, a complete passport English name is used to fill the transnational referral form, but a translated Chinese name or an incomplete English name is often used in NNDS because the system only accepts 10 characters in the name column. Foreign laborers' names are usually longer than 10 characters. If the foreign laborers' home countries request for details about their personal information and treatment course through focal points of international health regulation, our public health workers will have to compare a lot of data including the date of initial diagnosis, name, and the date of repatriation to find the correct person of interest. This is not only time consuming but also potentially making mistake.

There are some limitations in this study. First, we only targeted foreign laborers in central Taiwan, whether the results can be applied to all foreign laborers still need further studies. Second, the quality of sputum sampling can determine the results of the sputum studies. If the foreign laborers use saliva instead of adequate sputum, the smear positive rates and culture positive rates can be lower than they should be and cannot be used to compare with the sputum positive rates in Taiwanese patients. Third, the duration of anti-TB treatment before repatriation was calculated according to the data recorded in NNDS, so the accuracy depends on the in charge public health workers. Anything not recorded in the system can result in underestimate of the treatment duration.

In conclusion, our study found that both smear positive rates and culture positive rates were far lower among repatriated foreign laborers with pulmonary TB than in Taiwanese patients between July 2009 and February 2012. In addition, only 29.4% of repatriated foreign laborers had taken at least 14-days of anti-tuberculosis treatment before repatriation; only 19.9% of the passport numbers and names were consistent in transnational referral forms and in NNDS. To protect Taiwanese citizens from getting

infection without compromising foreign laborers' work right, more specific diagnostic strategies and more aggressive treatment before repatriation are of great importance.

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Outbreak Investigation Express

The Overview of Human Infection Caused by Avian Influenza A (H7N9) Virus

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Abstract

On March 31, 2013, China announced the first known human case infected by avian influenza A (H7N9) virus. By April 15, the total number of human H7N9 influenza cases reached 60 in China, including 13 deaths, 38 with severe illness, and 9 with mild illness, which were reported from Shanghai, Jiangsu, Zhejiang, Anhui, Beijing and Henan. Several cases had poultry contact history or had butchered bird meat before the onset of illness. The genome sequencing of the isolated viruses indicated a triple reassortment virus with avian origin. The first family cluster of human H7N9 infection was reported in Shanghai on April 13, suggesting that limited human-to-human transmission might occur. Currently, no human H7N9 influenza confirmed case has been reported in Taiwan. Human H7N9 influenza was listed as Category V Notifiable Infectious Disease since April 3. By April 15, 68 suspected cases were reported. Of them, 67 were excluded (including 13 H1N1, 5 H3N2 and one influenza B) and one was pending diagnostic tests. To cope with the emerging human H7N9 influenza outbreak in China, the Central Epidemic Command Center for H7N9 influenza was established on April 3 for prompt infection control and prevention measures, such as gathering latest infection information, strengthening border quarantine, coordinating medical systems and stockpiles, and managing risk communication.

Keywords: Avian influenza, H7N9

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