

# Factors influencing completion of treatment among pulmonary tuberculosis patients

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**Objective:** This study aimed to understand the influencing factors of treatment completion among pulmonary tuberculosis (PTB) patients in Anhui province, eastern People's Republic of China, in order to provide scientific evidence for improving the follow-up rate and treatment completion rate.

**Methods:** A total of 262 PTB patients in six counties (districts) of Anhui province were investigated by questionnaire, and data about treatment interruption were collected.

**Results:** The main causes of treatment interruption were forgetting to take medicine (24.5%), drug side effects (23.3%), and symptomatic improvement (19.5%). The education background, patient type, cause of interruption, and tracking method were factors influencing completion of treatment (all  $P < 0.05$ ). The education level was positively associated with the treatment completion rate. New smear-positive patients had a significantly higher completion rate than others. The patients interrupted by drug side effects had the highest risk of interruption. In terms of the tracking method, the completion rate of patients tracked by the rural medical staff was significantly lower.

**Conclusions:** The management of PTB patients by medication supervision should be strengthened, especially for those with low education level and who had drug side effects, in order to improve their treatment completion rate.

**Keywords:** pulmonary tuberculosis, treatment completion, influencing factors

## Background

Tuberculosis (TB) is a chronic disease transmitted by the respiratory tract caused by *Mycobacterium tuberculosis*,<sup>1</sup> which may infect almost all body tissues and organs, but pulmonary tuberculosis (PTB) is the most common.<sup>2</sup> PTB continues to be a very serious disease in People's Republic of China.<sup>3–5</sup> With the progress of medical standards and the continual updating of the anti-TB drug, PTB is curable under the principles of early, combined, regular, moderate, and complete medication. However, PTB patients' treatment compliance directly affects the treatment effect, and treatment interruption can lead to increased risk of drug resistance in these patients.<sup>6–99</sup> PTB control work is difficult. A previous study has shown that the risk of drug resistance in PTB patients with treatment interruption was 13 times higher than that in patients without treatment interruption, and the drug resistance rate was significantly higher than that of patients without interruption.<sup>10</sup> In developing countries, PTB patients with drug side effects, poverty, and low level of education were not highly compliant in the treatment, and patients were prone to treatment interruption.<sup>11–13</sup> In this study, we explored the main causes of treatment interruption and influencing factors of treatment completion among PTB patients in

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Anhui province, eastern People's Republic of China, so as to provide a scientific basis for reducing the treatment interruption rate among TB patients and improving the patient tracking rate and the treatment completion rate.

## Patients and methods

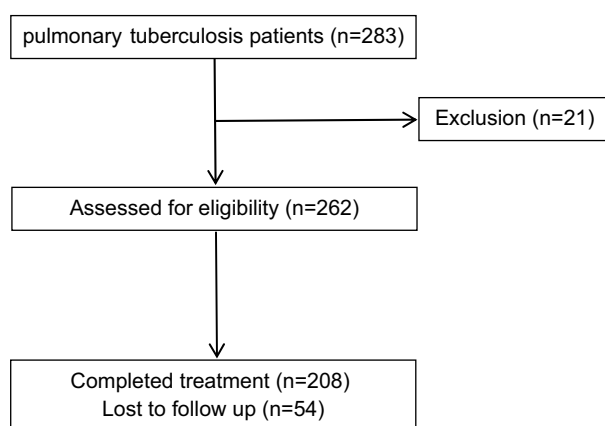
### Patients

Anhui province is divided into three regions (Jiangnan, Jianghuai, and Huaibei), and two counties (districts) were randomly selected from each region. Using a stratified cluster sampling method, 283 PTB patients who had an interruption (stop taking the drug for one week or more) in treatment between March 1, 2014 and November 30, 2014 were selected from six counties (districts); 262 valid questionnaires were retrieved (Figure 1).

### Methods

A self-designed questionnaire included general information (such as the social, demographic, and economic characteristics of PTB patients), patients' treatment interruption, tracking methods, and treatment outcomes. Before the investigation, relevant experts were invited to conduct special training on the investigation among the investigators, focusing on the questionnaire survey techniques and quality control during the survey. A pilot area was selected to conduct the pre-surveys, and then the content of the questionnaire was revised according to the pre-survey results.

The study procedure was approved by the ethics committee of Anhui Provincial TB Institute. Written informed consent was provided by the participants, and the study was conducted in accordance with the Declaration of Helsinki.



**Figure 1** Patient recruitment flow chart.

## Statistical analysis

Data were input and validation was performed with the double entry method using EpiData software version 3.1. SPSS version 23.0 was used for data analysis. Continuous variables were presented as mean±SD. The difference in categorical data among different groups was compared by  $\chi^2$ -test, and multiple logistic regression analyses were used to access the association between the completion rate and influencing factors.  $P \leq 0.05$  was considered to be statistically significant.

## Results

### Demographic characteristics of patients, causes of interruption, and follow-up situation

All of the selected 283 PTB patients were investigated for socioeconomic and demographic characteristics, interruption of treatment, follow-up, and treatment outcome. A total of 262 valid questionnaires were retrieved, so the effective rate of the questionnaire was 92.6%. Among the 262 patients surveyed, there were 197 males (75.2%) and 65 females (24.8%) with a mean age of  $51.42 \pm 19.93$  years. The majority of patients had only a primary education level or below (47.3%). The main causes of interruption were drug side effects (23.3%) and forgetting to take medicine (24.5%) (Table 1).

### Influencing factors of the treatment completion rate

In the univariate analysis, education background, marital status, patient type, cause of interruption, and tracking methods were influencing factors of the treatment completion rate (all  $P < 0.05$ ). For example, the completion rate of patients with higher education level was higher than that of patients with lower education level. The completion rate of divorced or widowed patients was the lowest (54.55%). The completion rate of new smear-positive patients (86.83%) was significantly higher than that of other patients. In terms of the cause of interruption, the completion rate of patients who were interrupted due to forgetting to take medicine was the highest (93.85%), while patients who were interrupted by drug side effects had the lowest completion rate (54.10%). With regard to tracking personnel, the completion rate was significantly lower in patients

**Table 1** The demographic characteristics of patients, causes of interruption, and follow-up situation

Index		Number	Composition ratio (%)
Gender	Male	197	75.2
	Female	65	24.8
Education background	Primary school or below	124	47.3
	Junior high school	45	17.2
	High school or above	93	35.5
Vocation	Farmer	183	69.8
	Worker, self-employed, and services	46	17.6
	Other	33	12.6
Marital status	Single	43	16.4
	Married	197	75.2
	Divorced or widowed	22	8.4
Sputum to find tuberculosis bacteria	Positive	167	63.7
	Negative	81	30.9
	Other	14	5.3
Cause of interruption	Poverty	31	11.8
	Side effects	61	23.3
	Traffic inconvenience	25	9.5
	Forgetting to take medicine	65	24.5
	Symptomatic improvement	51	19.5
	Other	29	11.1
	Tracking personnel	Urban staff	159
Rural staff	73	27.8	
Other	30	11.5	

who were followed by rural medical staff than that in patients followed by urban medical staff (Table 2).

In multivariate analysis, four variables (education background, patient type, reason for interruption, and tracking method) appeared in the last step of the forward stepwise logistic regression model. Patients with an education background of junior high school had 3.28 times higher risk of non-completion than patients with an education background of high school or above, and patients with an education background of primary school or below had 4.7 times higher risk of non-

completion than patients with an education background of high school or above. Smear-negative TB patients had 3.95 times higher risk than smear-positive TB patients. Regarding the reason for interruption, patients interrupted by drug side effects had the highest risk of non-completion. In terms of tracking personnel, patients who were tracked by urban medical staff had the lowest risk of non-completion (Table 3).

## Discussion

As a chronic infectious disease, treatment of PTB usually requires a long period, generally at least half a year. In the treatment process, affected by many factors, patients are prone to treatment interruption. Thus, it affects the therapeutic effect for TB patients, and can even lead to the occurrence of drug resistance.<sup>14,1515</sup> There are many causes of treatment interruption among PTB patients. The causes of interruptions are different in patients from different regions, vocations, and education background.

Our study suggests that education background, patient type, cause of interruption, and tracking method were factors affecting the treatment completion rate. The lower the education level, the lower the rate of completion. The possible reason is that patients with lower educational level may lack related knowledge about TB and awareness of the importance of regular treatment, thus they are less likely to complete treatment.<sup>1616</sup> Previous studies found that the main influencing factor of treatment completion was a lack of knowledge about the disease, and better-educated patients were at lower risk of non-completion.<sup>11,16-18</sup> In terms of patient type, smear-positive TB patients had a higher completion rate than smear-negative TB patients. It may be that the greater the perceived disease severity, the higher the treatment completion rate, which is similar to the results of a previous study.<sup>19</sup> Our study found that the main causes of the treatment interruption were forgetting to take medicine, drug side effects, symptomatic improvement, poverty, traffic inconvenience, etc, which is consistent with several previous studies. Wei et al<sup>15</sup> reported that the first three causes of treatment interruption in PTB patients were drug side effects, forgetting to take medicine because of busyness, and symptomatic improvement. Actual disease severity may affect the adherence to treatment, and patients were prone to interruption after feeling better.<sup>19</sup> Long et al<sup>20</sup> reported the relationship between treatment cost and adherence, and

**Table 2** Factors related to the treatment completion rate of patients

Factor		Treatment completed		Lost to follow up		$\chi^2$ -value	P-value
		n	%	n	%		
Gender	Male	158	80.20	39	19.80	0.32	0.571
	Female	50	76.92	15	23.08		
Education background	Primary school or below	83	66.94	41	33.06	23.85	<0.001
	Junior high school	38	84.44	7	15.56		
	High school or above	87	93.55	6	6.45		
Marital status	Single	38	88.37	5	11.63	10.50	0.005
	Married	158	80.20	39	19.80		
	Divorced or widowed	12	54.55	10	45.45		
Sputum to find tuberculosis bacteria (initial treatment)	Positive	145	86.83	22	13.17	15.61	<0.001
	Negative	54	66.67	27	33.33		
	Other	9	64.29	5	35.71		
Vocation	Farmer	142	77.60	41	22.40	1.98	0.372
	Worker, self-employed, and services	40	86.96	6	13.04		
	Other	26	78.79	7	21.21		
Reason for interruption	Poor	25	80.65	6	19.35	34.41	<0.001
	Drug side effects	33	54.10	28	45.90		
	Traffic inconvenience	22	88.00	3	12.00		
	Busyness or forgetting to take medicine	61	93.85	4	6.15		
	Symptomatic improvement	42	82.35	9	17.65		
	Other	25	86.21	4	13.79		
Tracking personnel	Urban staff	142	89.30	17	10.69	24.33	<0.001
	Rural staff	47	64.38	26	35.61		
	Other	19	63.33	11	36.67		

higher cost leads to higher likelihood of non-adherence. In addition, our study found that patients interrupted due to drug side effects had the highest risk of non-completion. Regarding the tracking personnel, the completion rate of patients tracked by rural medical staff is significantly lower than for patients who were followed by urban medical staff. In accord with previous studies,<sup>21-24</sup> the higher the level of tracking personnel, the higher the treatment completion rate. Obviously, medical staff not only spread knowledge about TB, but also make patients aware of the importance of regular treatment. We think that urban medical staff have a higher level of health education than rural medical staff, and patients tracked by urban staff also thought they got more attention, thus they had more confidence to be cured.

The study has some limitations. Firstly, the information of reason for interruption was based on self-report by patients, thus recall bias was inevitable. Secondly, we

only investigated six counties (districts) in Anhui province, and the sample size was small, which may restrict the generalizability of our results.

## Conclusion

Education background, patient type, reason for interruption, and tracking method are influencing factors of the treatment completion rate. In the future, the treatment management of TB patients should be strengthened, especially for patients with low educational level and drug side effects. Then, further reducing the medical burden of patients with financial difficulties in families, encouraging patients to cohabit with relatives, family members playing the role of supervision, standardizing diagnosis and treatment, and strengthening medication supervision could significantly improve the treatment compliance of TB patients, and further achieve the purpose of reducing drug resistance and improving the cure rate.

**Table 3** Factors related to the treatment completion rate of patients by logistic regression analysis

Factor		OR (95% CI)	P-value
Education background	Primary school or below	4.70 (1.69–13.08)	0.012
	Junior high school	3.28 (0.90–11.89)	
	High school or above	1.00	
Sputum to find tuberculosis bacteria (initial treatment)	Positive	1.00	<0.01
	Negative	3.95 (1.77–8.83)	
	Other	7.08 (1.70–29.47)	
Reason for interruption	Poor	1.00	0.021
	Drug side effects	2.54 (0.78–8.17)	
	Traffic inconvenience	0.74 (0.14–4.02)	
	Busyness or forgetting to take medicine	0.32 (0.07–1.43)	
	Symptomatic improvement	1.21 (0.33–4.48)	
	Other	0.66 (0.13–3.43)	
	Tracking personnel	1.00	
Tracking personnel	Rural staff	5.14 (2.22–11.91)	<0.01
	Other	4.59 (1.57–13.42)	

## Disclosure

The authors report no conflicts of interest in this work.

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