

# Original Article

## Noncompliance with treatment for pulmonary tuberculosis in Cuiabá, in the State of Mato Grosso - Brazil\*

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### ABSTRACT

**Objective:** To analyze factors predictive of noncompliance with pulmonary tuberculosis treatment. **Methods:** A historical cohort study involving 481 of the 529 active tuberculosis patients registered with the Tuberculosis Control Program in the city of Cuiabá, located in the state of Mato Grosso, during the 1998-2000 period. Data were obtained by analyzing medical charts and registration records. In the bivariate analysis, the chi-square test was used to calculate noncompliance rate ratios (relative risk), 95% confidence intervals were determined, and Fisher's exact test was used. The choice to estimate the rate of incidence was the method of density and a multivariate logistic regression model was constructed in order to identify the variables that were most predictive of noncompliance, using a level of statistical significance of  $p < 0.05$ . **Results:** The global rate of incidence was 27.3%, equivalent to 5.1 noncompliant patients/100 patients/month, increasing in the second and third months of treatment. In the final logistic regression model, the following were considered predictors of noncompliance: unsupervised treatment (odds ratio: 2.58; 95% confidence interval: 1.64 - 4.06;  $p < 0.001$ ); having been treated during the 1998-1999 period (odds ratio: 1.43; 95% confidence interval: 1.14 - 1.80;  $p = 0.002$ ); being male (odds ratio: 1.39; 95% confidence interval: 1.10 - 1.76;  $p = 0.005$ ) and having been out of compliance with previous treatment regimes (odds ratio: 1.37; 95% confidence interval: 1.06 - 1.78;  $p < 0.017$ ). **Conclusion:** The results indicate an elevated incidence of noncompliance and show that unsupervised treatment, year in which treatment was received, male gender and prior noncompliance were predictors of future noncompliance.

**Keywords:** Tuberculosis, pulmonary/therapy; Treatment refusal; Cohort studies

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## INTRODUCTION

The epidemiological profile of tuberculosis in the state of Mato Grosso is similar to that of other states in Brazil. In 1998, the reported incidence of individuals with active tuberculosis was 27.9/100,000 inhabitants. Of these, 72.6% were cured, 16.6% were noncompliant with treatment, and 5.7% died, with marked differences among the various regions in the state. In the city of Cuiabá, located in Mato Grosso, 299 new cases were reported in 1998. Of those 299, 143 were identified as active tuberculosis, an incidence of 31.9/100,000 inhabitants. Of those 143 patients (all older than 15 years of age), 75.2% were cured, and 16.1% were noncompliant with treatment.<sup>(1)</sup>

Noncompliance with treatment is considered one of the most serious problems in tuberculosis control because it implies persistence of the infectious source and increases in the rates of mortality and recurrence, as well as facilitating the development of resistant bacillus strains.<sup>(2-3)</sup> There are various levels of noncompliance, ranging from absolute refusal or irregular use of medication to not completing the treatment regimen.<sup>(4)</sup> Factors associated with noncompliance are generally related to patient behavior, the type of treatment adopted and the behavior of individuals working for or with health care facilities.<sup>(3,5-6)</sup>

In 1998, in order to improve effectiveness of the Tuberculosis Control Program in the city of Cuiabá, a supervised treatment plan was initiated in 1998. By the year 2000, the plan included all public health care facilities in the city. Considering that knowledge of the dynamics of noncompliance is essential for the effective control of tuberculosis, the objective of the present study was to identify factors related to noncompliance with treatment for active pulmonary tuberculosis in the city of Cuiabá in order to serve as a basis for health programs that are necessary for the local control of the endemic.

## METHODS

The present study was carried out from 1998 to 2000 and was conducted in 18 of the 63 city of Cuiabá health care centers in which the Tuberculosis Control Program had been implemented. Of those 18, 11 were primary outpatient health care facilities, 5 were secondary health care polyclinics, 1 was a

specialized outpatient clinic for the treatment of tuberculosis and acquired immunodeficiency syndrome, and 1 (which was operating under the auspices of a university hospital) was a specialized clinic for the treatment of tuberculosis and leprosy. Patients were referred by other health care centers or through spontaneous demand. The health care centers participating in the present study provided personnel adequately trained for outpatient treatment: physicians, nursing staff and community health agents.

A historical cohort study was conducted involving all patients with active tuberculosis registered with the Tuberculosis Control Program. Data collection was carried out during two overlapping periods: from December of 2000 through April of 2001; and from December of 2000 through June of 2001. In the first period, patients who had started treatment for tuberculosis by June of 2000 were selected in December of 2000, and data regarding these patients were collected from January to April of 2001. In the second period, patients who had started treatment between July and December of 2000 were also selected in December of 2000, but the data regarding these patients were collected from March to June of 2001.

The starting point of this study was the initiation of treatment and the different variables related to exposure (herein referred to as predictive variables). Only after this classification had been made did we identify outcomes (compliance/noncompliance). Medical charts included the duration of follow-up assessment. Since the month in which each patient began receiving treatment was recorded, we were able to evaluate those patients who completed the treatment regimen (6/month) as one group and the remaining patients (1-5/month) as another. Data for each patient were collected using a standardized form and stored in a specific database using the Epi Info program, version 6.0. Data were entered in duplicate and the Epi Info "Validate" tool was used in order to check data consistency and eliminate typographical errors.

Noncompliance with treatment was defined as having stopped taking the tuberculosis medication for more than 30 consecutive days,<sup>(7)</sup> and previous noncompliance was defined as having re-entered the health care system for treatment for tuberculosis after having previously been asked to leave the program due to their noncompliance.

Supervised treatment was defined as therapy that consisted of the direct administration of medication for tuberculosis by a health professional. The health professional not only delivered the medication but also observed and registered the ingestion of each dose. This procedure was carried out either by a health professional (at the health clinic) or by a community health agent (in the home of the patient). Supervised treatment modalities were subdivided into three subgroups: semi-supervised, supervised and strictly supervised.

Treatment was considered supervised when there was the ingestion of the specific medication was observed and registered five times a week during the first two months of daily treatment (self-administration on Saturdays and Sundays) and twice or three times a week during the last four months of daily treatment (self-administration on Saturdays and Sundays). Treatment was considered semi-supervised when the ingestion of the medication was observed and registered for less than 15 days. Treatment was considered strictly supervised when there was the daily observation and registration of the ingestion of the medication (self-administration on Saturdays and Sundays) during the entire six months of treatment. Treatment was considered unsupervised when specific medications for tuberculosis were always self-administered.

Inclusion criteria were residing in the city of Cuiabá, registered with the Tuberculosis Control Program, having been definitively diagnosed with active pulmonary tuberculosis, and being older than 14 years of age. In addition, participating patients must have been treated with one of the short-course regimens: Regimen I (recommended for new cases) - first phase (two months of rifampin, isoniazid and pyrazinamide), second phase (four months of rifampin and isoniazid); Regimen RR (recommended for retreatment) - first phase (two months of rifampin, isoniazid, pyrazinamide and ethambutol), second phase (four months of rifampin, isoniazid and ethambutol). A total of 529 patients were selected for the study. Of those, 481 were included. The other 48 patients were excluded for various reasons: 22 died during the study period, 14 experienced treatment failure, and 12 were referred to other facilities.

Data were obtained from the registry of the program regulated by the Ministry of Health, from the medical charts of individual patients, from

registration forms related to the supervised treatment, and from the records of the referral from the health care facility where the diagnosis was confirmed. In order to categorize the supervised treatment modalities, data from medical charts were compared to those from forms on dose supervision. When doses were reported as supervised on the form and were reported as "taken home" on the medical charts, treatment was classified as "unsupervised". The same procedure was used for the semi-supervised and strictly-supervised modalities, according to the previously described definitions.

Medical charts were identified as being the most relevant data source because of the wealth of information noted by the professionals who had cared for the patients. In order to minimize the problem of records containing "no information", we used the lists of confirmed cases from the Banco de Dados da Coordenadoria da Atenção Básica à Saúde da Fundação de Saúde Cuiabá (Basic Health Care Coordination Database of the Health Foundation of Cuiabá).(8) Data regarding diagnostic confirmation (through direct sputum smear microscopy or culture and the presence of pulmonary cavitation on X-rays) were obtained through the assessment of the test results annexed to the medical chart of each patient studied.

Four age brackets were defined: 15-29, 30-49, 50-59, and 60 and up. The last age bracket was used as a reference. Educational level was defined as no schooling, from one to eight years of schooling or more than eight years of schooling. Again, the last group was used as a reference.

Regarding the dependent variable, the study group included patients who had complied with the treatment for less than five months (noncompliant patients), and the control group included all of the patients who completed the entire six months of treatment (compliant patients).

Exposure variables were age, gender, educational level, adverse effects, pulmonary cavitation, previous treatment, previous noncompliance, recurrence, hospitalization, month in which treatment was interrupted, and treatment modality. The variable "year in which treatment was received" was included in the study for the comparison between 1998 (prior to supervised treatment) and 2000 (with supervised treatment). Variables concerning professional activity and socioeconomic indicators could not be studied

since such data were not available in most of the medical records.

Bivariate analysis and multivariate regression were carried out in order to measure incidence rate ratios (relative risk) of compliant and noncompliant groups. However, we chose to use the method of determining incidence density for the calculation of these rates.<sup>(8-10)</sup> In this method, the number of people/exposure period is initially calculated from the moment when the event of interest takes place (noncompliance). In this case, the observation period of each individual was calculated from the time at which treatment began until either the confirmation of noncompliance or the end of the six-month treatment period, which is considered complete treatment for tuberculosis.

Initially, the bivariate analysis centered on the search for correlations between each independent variable and the response variable (compliance or noncompliance) in order to identify the main variables correlated with treatment noncompliance. Finally, SPSS version 9.0 software was used to construct a multivariate logistic regression model in order to better adjust the variables found to be predictive of the response variable.

For the selection of the independent variables included in the regression, we individually tested each variable in the model, using the following criteria for inclusion in the multivariate model: variables in which the descriptive level of significance was less than or equal to 0.20 in the bivariate analysis; variables that, in spite of presenting a  $p$  value  $> 0.20$  in the bivariate analysis, were considered relevant in the literature and were selected a priori as significant (gender, educational level, previous treatment for tuberculosis). These variables were maintained throughout the multivariate analysis process and were only excluded during the construction of the final model since their exclusion did not alter the significance of those that remained in the final model.

The study was submitted to and approved by the Research Ethics Committee of the Hospital Universitário da Universidade Federal do Mato Grosso (University Hospital of the Federal University of Mato Grosso).

## RESULTS

Of the 481 patients studied, 308 (64%) were male, and 173 (36.0%) were female. Noncompliance with treatment was higher among males (94 patients; 30.5%). Mean age was 39.9 years for males and 37.5 years for females. Noncompliance with treatment was proportionally similar in all age groups, although it was slightly higher in the 30-49 age bracket. The incidence of noncompliance during the study period was 27.3%, and the percent of noncompliance among individuals in retreatment was 39%.

The total number of individuals studied/month during the study period was 2456: 362 noncompliant patients/month and 2094 compliant patients/month. The highest frequency of noncompliance occurred between the second and third months of treatment, with an accumulated percentage of 75.8% (Table 1), a mean follow-up duration of 2.7 months, and a median/mode of 3 months.

The percentages of noncompliant patients with a history of hospitalization due to the disease or to the incidence of side effects caused by antituberculosis drugs were similar (23% and 24.3%, respectively). No statistically significant differences between the two groups were detected in terms of hospitalization, adverse effects and pulmonary cavitation.

Table 2 shows that the noncompliance incidence density was higher in males than in females (6.10 patients/month vs. 4.15 patients/month), and that this difference was significant (relative risk = 1.47;  $p = 0.047$ ). The comparison among the four originally defined age brackets showed no statistically significant difference. Reorganizing the cases into only two age brackets (15-49 and over 49) also resulted in no statistical difference ( $p = 0.419$ ). Regarding educational level, there was a statistically borderline difference between the group of individuals having had 1-8 years of schooling and the other two groups (relative risk = 1.53;  $p = 0.058$ ). Grouping patients having had no formal education together with those having had 1-8 years of schooling, we found the noncompliance incidence density to be higher among patients with less schooling, and this difference was statistically

TABLE 1

Distribution of the patients studied - by month in which noncompliance occurred, as well as by number/percentage of noncompliant patients/month and of compliant patients/month during the 1998-2000 period in the city of Cuiabá, located in the state of Mato Grosso, Brazil

		Month in which noncompliance occurred						Total
		1st	2nd	3rd	4th	5th (endpoint)	6th	
Observation period	0	1	2	3	4	5	6	
Number of cases	1	23	28	48	21	11	0	132
Percentage	(0.8)	(17.4)	(21.2)	(36.4)	(15.9)	(8.3)		(100)
Noncompliant patients/mo	0	23	56	144	84	55	0	362
Compliant patients/mo	0	-	-	-	-	-	349	2094
Total*								2456

mo: month; \*Total number of patients (compliant and noncompliant)

significant (relative risk = 1.56; p = 0.043). Regarding the reason for treatment, noncompliance incidence density was three times higher among patients with a previous history of noncompliance (13.97/100 patients/month) than among those who were considered treatment naïve (reference category; 4.73/100 patients/month), and this difference was

also statistically significant (relative risk = 2.89; p < 0.001).

In comparing strictly supervised treatment with the other types of supervised treatment (Table 3), we found that the risk of noncompliance correlated only with unsupervised treatment (p = 0.002). Supervised and semi-supervised treatments were less

TABLE 2

Distribution of patients with active pulmonary tuberculosis by noncompliance incidence density according to various demographic variables and reason for treatment during the 1998-2000 period in the city of Cuiabá, located in the state of Mato Grosso, Brazil

Variable	n	Patients	Incidence	RR	(95% CI)	p
		/month	density			
<b>Gender</b>						
Female	38	916	4.15	1.00		
Male	94	1540	6.10	1.47	(1.01-2.14)	0.047
<b>Age bracket (years)</b>						
Over 60	14	282	4.96	1.00		
50-59	14	326	4.29	0.86	(0.41-1.81)	0.709
30-49	65	1006	6.46	1.30	(0.73-2.32)	0.417
15-29	39	842	4.63	0.93	(0.51-1.72)	0.874
<b>Age bracket (years)</b>						
Over 50	28	602	4.65	1.00		
15-49	104	1854	5.61	1.21	(0.79-1.83)	0.419
<b>Educational level</b>						
Over 8 years of schooling	27	702	3.85	1.00		
1-8 years of schooling	90	1533	5.86	1.53	(0.99-2.35)	0.058
No schooling	15	221	6.79	1.76	(0.94-3.32)	0.101
<b>Educational level</b>						
Over 8 years of schooling	27	702	3.85	1.00		
No schooling or 1-8 years of schooling	105	1754	5.99	1.56	(1.02-2.38)	0.043
<b>Reason for treatment</b>						
New patient	93	1968	4.73	1.00		
Recurrence	13	301	4.31	0.91	(0.51-1.63)	0.881
Previous noncompliance	19	139	13.97	2.89	(1.77-4.74)	< 0.001

RR: relative risk; 95% CI: 95% confidence interval

TABLE 3

Distribution of the patients studied by treatment modality and year treated during the 1998-2000 period in the city of Cuiabá, located in the state of Mato Grosso, Brazil

Variable	n	Patients /month	Incidence density	RR	(95% CI)	p
<b>Treatment*</b>						
StST	8	336	2.38	1.00		
ST	27	693	3.90	1.64	(0.74-3.60)	0.280
S-ST	7	272	2.57	1.08	(0.39-2.98)	0.999
UT	90	1,155	7.79	3.27	(1.59-6.74)	0.002
<b>Treatment*</b>						
AST	42	1,301	3.23	1.00		
UT	90	1,155	7.79	2.41	(1.67-3.48)	< 0.01
<b>Year of treatment**</b>						
1999-2000	75	1,828	4.10	1.00		
1998	57	628	9.08	2.21	(1.57-3.12)	< 0.01

RR: relative risk; 95% CI: 95% confidence interval; StST: strictly supervised treatment; ST: supervised treatment; S-ST: semi-supervised treatment; UT: unsupervised; AST: all (forms of) supervised treatment. \*Gross RR for noncompliance in the year of treatment; \*\*1998: year in which supervised treatment was initiated in health care facilities; 1999-2000: period during which supervised treatment became fully implemented

TABLE 4

Final model of the multivariate analysis of factors related to noncompliance with treatment for tuberculosis, showing odds ratios for noncompliance and their respective 95% confidence intervals and statistical significances

Variable	OR	95% CI	p
<b>Treatment modality</b>			
AST	Reference		
UT	2.58	(1.64-4.06)	< 0.001
<b>Year of treatment*</b>			
1999/2000	Reference		
1998	1.43	(1.14-1.80)	0.002
<b>Gender</b>			
Female	Reference		
Male	1.39	(1.10-1.76)	0.005
<b>Previous noncompliance</b>			
No	Reference		
Yes	1.37	(1.06-1.78)	0.017

OR: odds ratio; 95% CI: 95% confidence interval; AST: all (forms of) supervised treatment; UT: unsupervised treatment \*1998: year in which supervised treatment was initiated in health care facilities; 1999-2000: period during which supervised treatment became fully implemented

associated with noncompliance than was the strictly supervised treatment. Therefore, all individuals were regrouped into supervised or unsupervised treatment. In this new comparison, the incidence of noncompliance was 2.41 times higher among individuals in unsupervised treatment. In Table 3, we can also see that, regarding the year in which treatment was received, the incidence of noncompliance was lower in the 1999-2000 period (5.99/100 individuals/month) than in 1998 (10.93/100 individuals/month).

Table 4 shows the most significant variables that

were predictive of noncompliance (outcome variable) with the use of multiple logistic regression: treatment modality (unsupervised/supervised: odds ratio = 2.58; 95% confidence interval = 1.64-4.06;  $p < 0.001$ ); followed by the year in which treatment was received (1998/1999-2000: odds ratio = 1.43; 95% confidence interval = 1.14-1.80;  $p = 0.002$ ); gender (male/female: odds ratio = 1.39; 95% confidence interval = 1.10-1.76;  $p = 0.005$ ); and previous history of noncompliance with treatment for tuberculosis (odds ratio = 1.37; 95% confidence interval = 1.06-1.78;  $p = 0.017$ ).



## DISCUSSION

The overall incidence rate was 5.1 noncompliant patients/100 patients/month, which is equivalent to a noncompliance rate of 27.3% among all patients submitted to treatment in 1998, 1999 and 2000, a result in agreement with those of other studies, in which percentages ranged from 6.8% to 33.8%.<sup>(5,11-12)</sup> However, in the city of Cuiabá,<sup>(1)</sup> according to an evaluation carried out using data from the Sistema de Informação de Agravos de Notificação (Case Registry Database), the percentage of noncompliant patients (older than 15 years of age) with active tuberculosis was lower (16.1%), with accentuated decreases in 1999 and 2000 (to 7.7% and 4.9%, respectively).

An important question in noncompliance control is in which month the patient fell out of compliance. Patients generally present good general status with practically no clinical symptoms at the end of the first month of treatment and the beginning of the second. From this period on, the risk of noncompliance increases since many patients believe they are cured of the disease because they become asymptomatic.<sup>(11-12)</sup> Through the data analyzed in this study, noncompliance with treatment occurred, in the majority of the cases, between the second and the third months of the treatment regimen (21.2% and 36.4%, respectively). The accumulated percentage of noncompliance reached 75.8% by the end of the third month of treatment, which reinforces the above-mentioned observation (when the patient does not experience any symptoms of the disease, noncompliance increases). A similar percentage (61.5%) was reported in a study in which noncompliance also occurred primarily in the second and third months of treatment.<sup>(2)</sup> We should also take into consideration the fact that patients who interrupt treatment for more than two months become more susceptible to the development of drug resistance.<sup>(12-14)</sup>

In the present study, the incidence of noncompliance was higher among males, and the difference was statistically significant. Other authors have also reported significant gender-based differences, identifying male gender as a predictor of noncompliance.<sup>(15-16)</sup>

Educational level was a significant predictor of noncompliance since individuals with less schooling

(having had no schooling or less than 8 years of schooling) abandoned treatment 79.5% more often than those with more than 8 years of schooling, even though this fact was found to be less than significant in the multivariate analysis. These results are in agreement with those obtained by other authors, who have reported that lower level of education correlates with noncompliance only in the bivariate analysis.<sup>(2)</sup> Other studies have also shown that having had less schooling (functional illiteracy) is a predictor of noncompliance.<sup>(14,17)</sup>

Among the clinical characteristics of the individuals studied, hospitalization was considered an indicator of disease severity and was analyzed in order to determine whether or not it had an influence on noncompliance with treatment. No correlation was found between these two variables, whereas other studies in the literature have shown hospitalization to be a predictor of noncompliance.<sup>(2,5)</sup> However, the role of hospitalization in individuals with tuberculosis has been questioned as to whether or not it is likely to improve compliance with treatment. Being hospitalized may be more closely correlated with noncompliance since less effective treatment increases the chance of a worse prognosis by increasing disease severity. In contrast, patient perception of disease severity may induce greater compliance with treatment.

The side effects of the regimen used for the treatment of tuberculosis are well known and, when they occur, they cause disturbances on an individual level. Although we could expect that individuals who reported drug intolerance would be more likely not to comply with the treatment, we found no correlation between the incidence of adverse effects and that of noncompliance. This finding is in agreement with those of other studies.<sup>(5,18)</sup>

To date, the adverse effects of antituberculosis drugs have been addressed in the form of review articles, reports on effects alone or studies focusing on a single drug.<sup>(5,19)</sup> The Sociedade Brasileira de Pneumologia e Tisiologia (Brazilian Society of Pulmonology and Phthisiology) recommends that national controlled studies be incorporated into the routine of health care facilities in order to identify the most significant risk factors for the development of adverse effects caused by antituberculosis drugs. Such risk factors include advanced age, alcoholism, malnutrition, history of

previous liver disease and coinfection with human immunodeficiency virus (1997).<sup>(20)</sup>

Another significant clinical symptom that patients may present is pulmonary cavitation, which can be used as a criterion for identifying severe lung injury caused by the bacillus and is related to the immunological characteristics of patients. We could expect higher compliance with the treatment from patients who are aware of the severity of their disease, as evidenced by the presence of cavitation on chest X-rays. However, some authors have reported that disease severity decreases compliance with the treatment, and this may explain the fact that patients with chronic forms of tuberculosis remain in treatment.<sup>(18-20)</sup> Nevertheless, analyzing the results found in the present study and in another,<sup>(21)</sup> no correlation was found between this variable and noncompliance.

Our results show that previous noncompliance with treatment is a significant indicator of the quality of the Tuberculosis Control Plan. This variable remained as a predictor of noncompliance in the multivariate analysis. As in the present study, other authors have reported significant correlations between noncompliance with treatment and retreatment due to previous noncompliance.<sup>(3-5)</sup>

The risk of developing drug-resistant forms of tuberculosis is extremely high for patients having been treated previously, thereby resulting in treatment failure. For many of these patients, pulmonary injury caused by tuberculosis becomes more severe due to repeated reactivations and inadequate treatment, factors that favor the development of mutant strains of *M. tuberculosis* resistant to one or more drugs.<sup>(14,22)</sup> In a study carried out in Recife, in the state of Pernambuco,<sup>(23)</sup> it was reported that retreatment for tuberculosis was responsible for 39.7% of all cases of drug resistance. In view of this, continuous collection of enlightening information is a fundamental part of the success of the Tuberculosis Control Program, especially for those patients with a history of noncompliance with treatment for tuberculosis. In order to avoid the development of bacterial resistance, which can lead to the complete failure of the program, the treatment of such patients must be considered a priority.

When we analyzed the influence of the treatment modality on noncompliance with treatment, we found that the incidence of

noncompliance was lower in the supervised groups. Among unsupervised individuals, the rate of noncompliance was 2.41 times higher, and this treatment modality was the most significant predictor of noncompliance. We must also highlight the fact that semi-supervised and strictly supervised treatment had quite similar incidences of noncompliance (2.57 and 2.38, respectively), which led us to hypothesize that semi-supervised treatment, albeit less strict regarding the supervision of the ingestion of medication, may be as effective as the strictly supervised treatment. This was corroborated by the findings of another study.<sup>(24)</sup>

Nationwide studies conducted in Brazil, as well as international studies, have shown that the incidence of noncompliance is lower among tuberculosis patients in supervised treatment programs.<sup>(25-27)</sup> The proposal of the supervised treatment strategy is to guarantee compliance with the treatment since it requires that patients be supervised when they take antituberculosis drugs.<sup>(28)</sup> The great advantage of supervised treatment is that it identifies the problem of noncompliance at its inception, which creates the opportunity to take immediate corrective action. In contrast, when treatment is unsupervised, noncompliance typically becomes apparent only when patients fail to collect their medications, miss their medical appointments or admit to not taking the prescribed medication, which results in a delay in intervention by the health care team.

The fact that the incidence of noncompliance during the 1999-2000 period was lower than that seen in 1998 may provide evidence of an improvement in the performance of the program, and thereby better control of noncompliance with treatment, resulting from the adoption of supervised treatment. The approach of the present study, which aimed to identify factors associated with noncompliance with treatment for tuberculosis in Cuiabá, brought to light, through analysis of the results obtained using the various supervised treatment modalities, the beginning of a more comprehensive discussion on the feasibility of the use of supervised treatment as a regular practice in health care facilities. Supervised treatment should not be seen simply as supervision of the administration of medication but as a group of measures confirmed in practice and complemented



by the pillars of such treatment programs, as defined by the World Health Organization, including promoting the regularity of drugs and guaranteeing a system of registering data and information that assures the all-inclusive evaluation of the effectiveness of the program,(29-30) as well as greater involvement by health care, program and community professionals. This will also ensure that the Tuberculosis Control Program has a real and significant impact, especially in the identification and treatment of patients with active tuberculosis, who are exposed to a greater risk of becoming ill over the course of the infection.

We must consider the limitations of the method adopted in the present study, which may have created some biases such as selection bias (population highly exposed to the risk factor allocated to supervised treatment; population less exposed to the risk factor allocated to unsupervised treatment - although unsupervised treatment might have been more often prescribed for patients of higher educational and socioeconomic status); information bias (if the person responsible for registering the information was aware of the severity of the disease of patients, the information regarding such individuals might have been of a higher quality than that collected for individuals with better prognoses); confounding factors (in cohort studies, confounding factors can only be avoided during the design of the study through restriction or pairing, which was impossible in this study, although stratification and logistic regression were carried out in order to minimize this effect). We must also consider the overall quality of the data since this was a historical cohort study, and the data were obtained from secondary sources (registries, medical charts and forms).

The results shown herein allow us to conclude that the incidence of noncompliance with treatment for tuberculosis in Cuiabá is high, and that unsupervised treatment, male gender and prior noncompliance are predictors of future noncompliance. The year in which treatment was received (during the initiation phase or during the implementation phase) was also significant in the final model, indicating that the health care service analyzed in the present study improved during the last two years evaluated.

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