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Association of Notified Cases and Treatment Success Rates in Pulmonary Tuberculosis

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ABSTRACT

Background: Tuberculosis has long been recognized as a public health problem in large cities. The goals of the "Stop TB" strategy of the WHO specifically promote its study at the subnational level. Therefore, we aimed to describe the state of pulmonary tuberculosis (PTB) at the municipality level in Mexico. **Methods:** We obtained data on new cases of PTB and treatment success rates (TSRs) per municipality from each state in Mexico, reported by the Mexican Social Security Institute to the National Epidemiological Surveillance System during 2013. Regression model was used to quantify associations between PTB and TSR by the municipality. **Results:** We included 4090 cases of PTB distributed in 432 municipalities. There were 121 municipalities with TSRs < 85%. Lower TSRs were associated with older age, male sex, and comorbidities. **Conclusions:** Results suggest a negative outcome of PTB treatment in patients with HIV and in those with malnutrition. The number of reported cases by the municipality was not associated with a negative treatment outcome. (REV INVES CLIN. 2018;70:198-202)

Key words: Pulmonary tuberculosis. Success rates. Counties. Comorbidities.

INTRODUCTION

Pulmonary tuberculosis (PTB) has long been recognized as a public health problem in large cities worldwide[1]. In the "Global Plan to Stop TB" strategy designed by the World Health Organization, the goals are to reduce the prevalence and deaths from TB[2]. In recent years, the study of TB at the subnational level has been encouraged since reports show that while the national incidence decreases, the disease is concentrated in large cities. This phenomenon is most likely a result of higher concentrations of risk groups within these areas[3].

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The risk of transmission is greater in cities due to the high number of contacts and longer duration of the infectious period, which is aggravated by the lack of basic health services in many human settlements in marginalized urban areas. Cities also attract individuals from rural areas looking for better health services, thereby artificially increasing the number of TB patients reported[4-6].

There have been few studies of PTB at the local level[7,8], and in Mexico, these studies are especially rare[9-12]. Given the heterogeneous distribution of PTB incidence in Mexico, the Mexican National Tuberculosis Program is focusing on the analysis, control, and prevention in priority municipalities[13-15], defining municipality as a territorial administrative division in which a state is organized, which is governed by a municipality.

At the Mexican Social Security Institute (IMSS), which insures approximately 40% of the Mexican population[16], the TB surveillance system operates in all medical units at the three levels of care (1099 first-level units and 259 hospitals nationwide, of which 27 are third-level hospitals)[16]. It uses online reporting in real time through the National Epidemiological Surveillance System (SINAVE)[17], a platform for the notification and follow-up of TB cases in all its forms seen at any of the health institutions in Mexico. In addition, it is mandatory that all TB cases be reported according to official guidelines and registered in the National Tuberculosis Registry[18].

Given the need for strengthening the response capacity for the elimination of TB as a public health problem, our objective was to provide a description of the current situation of PTB at the municipality level, based on the number of cases and treatment success rates (TSRs) reported in SINAVE during 2013 by the IMSS.

METHODS

A retrospective cohort study was carried out in patients with PTB in Mexico. We obtained data on all cases of PTB reported by the IMSS in the SINAVE platform and the outcomes per municipality, nationwide, from January to December 2013. Notification and monitoring during treatment in all cases of PTB are made by the epidemiology and preventive medicine personnel of the treating medical unit. The database is administered by the Federal Secretary of Health of Mexico. Outcomes were defined according to official guidelines and the clinical record in the SINAVE platform. TSR included cured cases and treatment completion. Cure was considered when treatment was completed with the disappearance of signs and symptoms and two or more sputum acid-fast bacilli smears or cultures with negative results at the end of therapy. Treatment completion was defined when a patient completed the treatment regimen with the disappearance of signs and symptoms, and a sputum smear or culture was not performed. Abandonment of treatment was the interruption of treatment against PTB for 30 or more consecutive days (Mexican guidelines define treatment abandonment when treatment is interrupted for ≥ 30 days rather than for 60 days). Failure was considered when acid-fast bacilli sputum smears or cultures were positive at 5 months or later during treatment. Death was defined when a patient died from any cause during therapy (including death due to PTB and death from other causes). Previously treated (re-entry, relapse, and failure) cases were included. We used an application called State and Municipal Database System from the National Institute of Geography and Informatics (INEGI) to map the municipalities with TSR below 85%[19]; according to the Standards for Tuberculosis Care in Mexico, the goal in PTB should be a TSR of 85% or higher[20].

Associations between successful treatment in PTB cases and the number of notified cases by the municipality were investigated by multivariate logistic regression analysis, accounting for sex, age, comorbidities, and treatment status (new cases of PTB and those previously treated). We estimated the odds ratios (OR) and 95% confidence intervals (CI) and identified the covariates that were independently associated with the outcome.

RESULTS

We included 4090 cases of PTB in states recorded in the IMSS; of them, 59.9% were male, and the median age was 48 years (interquartile range [IQR] 29 years). Comorbidities were reported in 2341 cases (57.2%); of them, 1256 (30.2%) had diabetes and 158 (3.8%) had HIV infection. The cases were distributed in 432 municipalities; the median number of cases registered

per municipality was 2 (IQR = 7), and the range was 1-208 cases. The municipalities with the highest number of reported PTB cases were Tijuana, Baja California (208); Monterrey, Nuevo León (208); Acapulco, Guerrero (122); Veracruz, Veracruz (119); and Culiacán, Sinaloa (117); overall, these represent 19% of the total number of cases. The TSR was 85.7% (3507) (Table 1).

There were 121 municipalities with success rates lower than 85%, which represented 28% of the municipalities that notified PTB cases distributed throughout the country, mainly in the northern states and Baja California Peninsula (Fig. 1).

We performed a binary logistic regression analysis using as dependent variable successful PTB cases and as covariates age, sex, and number of notified cases by the municipality, and diabetes and HIV comorbidities; results are shown in table 2.

Table 1. Outcomes of pulmonary tuberculosis cases at the Mexican Social Security Institute, 2013

Status	Frequency (%)
Positive outcome	
Cure	2679 (65.5)
Completed treatment	828 (20.2)
Success (cure + completed treatment)	3507 (85.7)
Negative outcome	
Death from PTB	101 (2.5)
Other causes of death	208 (5.1)
Abandonment of treatment	200 (4.9)
Failure	74 (1.8)
Unsuccessful treatment	583 (14.3)

PTB: pulmonary tuberculosis

DISCUSSION

Population-based studies at the local level are uncommon[7,8]; in Mexico, they are especially rare[9-12] but have recently been promoted by the National Tuberculosis Program[14,15]. Assessment of both the presence of cases and their cure rates yields a cross-sectional evaluation of the health services; in this study, we show that the TSR, 85.7%, was higher than the standard rate, with important variations between municipalities. A negative outcome of treatment in PTB cases was associated with the patient's older age, male gender, re-entry to treatment, pre-treatment

Figure 1. Geographical distribution of municipalities with a pulmonary tuberculosis (PTB) treatment success rate below 85%, Mexico, 2013.
Green color = municipality with PTB treatment success rate below 85%.

Table 2. Association of unsuccessful pulmonary TB treatment*, by multivariate analyses. Mexican Social Security Institute, 2013

Variables	Adjusted OR	95% CI		p value
		Lower	Upper	
Age (years)	1.015	1.009	1.020	0.000
Male	1.644	1.354	1.997	0.000
Number of PTB cases notified by municipality	1.000	0.999	1.002	0.866
Type of PTB				
New case	1.000			0.000
Failure before PTB treatment	5.581	2.091	14.897	0.001
Relapse of PTB	1.299	0.896	1.883	0.167
Re-entry to treatment	2.155	1.268	3.662	0.005
None	1.000			0.000
HIV	2.532	1.717	3.736	0.000
Alcoholism	0.949	0.567	1.588	0.841
Diabetes mellitus	0.911	0.725	1.145	0.423
Malnutrition	1.970	1.407	2.758	0.000
Cirrhosis	1.541	0.318	7.458	0.591
Neoplasia	2.688	0.929	7.781	0.068
Heart failure	1.763	0.555	5.602	0.336
Chronic obstructive pulmonary disease	0.929	0.471	1.832	0.831
Pulmonary edema	2.106	0.768	5.775	0.148
Pregnancy	0.000	0.000		0.999
Drug abuse	2.899	0.257	32.663	0.389
Other	1.258	0.920	1.720	0.150
Constant	0.051			0.000

OR: Odds radio, CI: confidence intervals, PTB: pulmonary tuberculosis
*Unsuccessful case. Status included: death from PTB, other causes of death, abandonment of treatment, and failure[a]Expressed as a mean ± standard deviation
[b]Expressed as a median and interquartile range

failure, and comorbidities such as HIV infection and malnutrition.

The number of cases reported per municipality was not related to the outcome of treatment in PTB patients. On the other hand, municipalities with a low TSR and high circulation of mycobacteria condition an increase in cases, creating a vicious cycle[12].

An issue not evaluated in this paper was the effect of migration since it has been considered to increase TB transmission rates. Migrants are a target for screening for active and latent TB infection as a main strategy to manage risk and minimize transmission[21]. This is more likely the reason why most new PTB cases are detected in the northern states across the country.

We found that one-fifth (20.2%) of cases were classified as treatment completion without sputum smear or culture; an explanation could be that symptoms disappear when there is an adequate treatment, and it becomes difficult to obtain a control sample. The importance of bacteriological monitoring lies in that successfully treated patients are no longer transmitters of the disease.

In relation to comorbidities and TSRs, our findings showed that patients with HIV infection and those with malnutrition had a greater probability of treatment failure, consistent with what was published in another study[22]. The effectiveness of the current approach to the treatment of TB patients regardless of HIV status has been documented[23]. However, in our study, HIV infection was a risk factor (OR = 2.5; 95% CI = 1.7-3.7) for unsuccessful PTB treatment; this difference could be due to the type of patient included, *i.e.*, new cases or previously treated PTB cases.

A key contribution of our study is that we analyzed data on municipalities since currently there is little information of this kind in Mexico. The National Tuberculosis Program has started to conduct this type of analysis to focus the efforts in priority municipalities[14]. In a cohort study of new bacteriologically positive PTB cases in Mexico during 2013, the municipalities with the highest incidence were Acapulco, Guerrero; Tapachula, Chiapas; Veracruz, Veracruz; Tijuana, Baja California; Nuevo Laredo, Tamaulipas; Piedras Negras, Coahuila; Mexicali, Baja California; Poza Rica, Veracruz; Ensenada, Baja California; and Puerto Vallarta, Jalisco, similar to what we found in our study[13]. TSRs for these municipalities ranged from 81% to 95%. Subsequent scenarios were established according to the incidence rate per 100,000 inhabitants and included general recommendations for actions in each scenario, contained in an internal report of the Ministry of Health in Mexico[15]. Our study is one of the first reports published in a scientific journal on the subject.

The limitations of the study include the fact that the presence of the IMSS is heterogeneous among states, with a smaller presence in Chiapas and Oaxaca, leading to a possible bias. The strengths of this study are, first, that the source of information is a surveillance system from a single health sector, conducted at various organizational levels (i.e., operational, jurisdictional, state, and national). Second that the study involved all medical units ordinarily tracked by the IMSS. And third, that it covered all new cases notified in a year under ordinary circumstances. We conclude that the outcome of PTB treatment is negative in patients with diabetes. The number of reported cases by the municipality was not associated with an adverse treatment outcome. The results published here are from patients treated at the IMSS, which, as mentioned earlier, insures 40% of the population, and do not necessarily reflect the overall performance of the program in the country.

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