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Tuberculosis in Brazil: last ten years analysis – 2001–2010

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ABSTRACT

Objective: To describe tuberculosis epidemiological situation in Brazil, as well as program performance indicators in 2001–2010 period, and discuss the relationship between changes observed and control measures implemented in this century first decade.
Methods: It is a descriptive study, data source was the Information System for Notifiable Diseases (Sinan), Mortality Information System (SIM), Unified Health System Hospital Information System (SIH/SUS) and TB Multidrug-resistant Surveillance System (MDR-TB/SS). Indicators analyzed were organized into four major groups: TB control program (TCP) coverage and case detection; morbidity; treatment and TCP performance; and mortality.
Results: In the years analyzed there was a decrease in the number of new cases and incidence rate, mortality reduction (relative and absolute), and improvement in TB detection and diagnosis, as well in TB/HIV coinfection and drug resistance. However, little progress was found in contact investigation, diagnosis in primary care and TB cure rate.
Discussion: Results showed many advances in tuberculosis control in the 10 years analyzed, but it also points to serious obstacles that need to be solved so Brazil can eliminate tuberculosis as a public health problem.

Introduction

Although tuberculosis (TB) has an effective treatment for decades, with the resurgence of the disease in the 80s and 90s, as a result of the AIDS epidemic, the World Health Organization (WHO) established TB as a global public health emergency in 1993.

At the time, it was estimated a total of 7–8 million incident cases of TB and 1.3–1.6 million deaths per year worldwide.[1] Likewise, recognizing TB as a major global health problem, the United Nations (UN) included tuberculosis in the Millennium Development Goals in 2000. TB is present in the sixth goal and the global targets set for 2015 include reducing the incidence and mortality of the disease by 50% when compared to 1990.

Brazil is of the 22 countries with high burden of the disease worldwide. The number of TB incident cases has decreased on average 1.3% per year in the world since 2002 and mortality was reduced by a third since 1990. If these trends continue, global targets for TB control could be achieved. Brazil has a decreasing trend in incidence rate and according to WHO estimates has reached the goal of start reducing mortality.[1]

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As the main strategy for tuberculosis control, in order to reduce default and death from TB and increase cure, WHO adopted the Directly Observed Treatment Short-Course (DOTS). The strategy includes six components: political commitment, case detection by microscopy sputum smear, standardized treatment, directly observed treatment (DOTS), regular and uninterrupted standardized drugs supply and reporting case system.[2] This strategy importance is to make treatment outcome not only a patient responsibility, but also a compromise between them and health care system from diagnosis to discharge. Government should make TB control a political priority giving all logistics and strategic conditions necessary in the way.

As tuberculosis became a priority inside the Health Ministry (HM) DOTS strategy and decentralization of TB control to primary care began to strengthen. The increasing national budget, the presence of TB in different instruments of agreement between federal government, states and municipalities, provided increased visibility to TB, both technical and political.

Over the last decade, TB National Control Program (NTP) has been engaged in disseminating morbidity and mortality data from their information systems in publications as the Brazil Health Series, epidemiological bulletins and scientific articles. The intention is subsidize decision-making and adoption of public policies in the three levels of management with information generated from surveillance data. This study aims to describe TB epidemiological and controlling situation in Brazil, in the 2001–2010 period, and discuss the relationship between changes observed and control measures proposed in this century first decade.

Methods

It is a descriptive study of TB notified cases, hospitalizations and deaths occurred in Brazil in the 2001–2010 period.

Data sources used were the Information System for Notifiable Diseases called Sinan-TB (updated on November 2011), the Mortality Information System called SIM, the Unified Health System Hospital Information System called SIH/SUS, the Multidrug-Resistant Tuberculosis Surveillance System called MDR-TB/SS, the Health Establishment National Register and the population bases from the Informatic Department of Unified Health System called Datasus.

The definition of new TB case followed the guidelines included in the Recommendations Manual for Tuberculosis Control in Brazil.[3] Qualifications on TB records in Sinan were made by states and municipalities, through out surveillance routines performed, and by national level by checks on information available on national basis.[3]

Epidemiological and operational TB data were analyzed for the period of 2001–2010, and were aggregated by year of diagnosis, Brazil and Federal Units (FU) of residence. The variables "institutionalized", "contacts investigated" and "supervised treatment performed" were inserted in Sinan in 2007. For this reason, they were only described after this year.

For data analysis were used the softwares EpiInfo 3.5.2, Microsoft Excel® 2010 and Microsoft Access® 2003. The indicators analyzed were organized into four major groups: TB control programs (TCP) coverage and case detection; morbidity; treatment and PCT performance; and mortality.

TCP coverage and case detection

- Percentage of municipalities which diagnosed TB cases. Case notification was used as a proxy of diagnosis;
- Percentage of TB cases diagnosed in primary care facilities (PCF);
- DOTS coverage in health facilities. The variable "supervised treatment performed" was used to analyze this indicator and WHO's recommended concept of DOTS coverage in the health unit in which the health unit with at least one case in DOTS was accounted for in analysis; and
- TB detection rate for all forms of the disease. WHO's estimate number of cases in Brazil was used for comparison.

Morbidity

- Crude incidence rate per 100,000 inhabitants;
- Percentage of TB cases by type input in the information system (new, retreatment and transfers);
- Percentage of new cases by sex, age, race, education, and institutionalization;
- Percentage of new cases according to clinical form;
- Number of cases of MDR-TB; and
- Percentage of TB/HIV cases by total of new cases.

Treatment and TCP performance

- Percentage of smear tests performed by total of new pulmonary cases;
- Percentage of new cases tested for HIV (only the positive and negative cases were accounted, "in process" were discarded);
- Percentage of contacts investigated among contacts identified;
- Percentage of new cases regarding the closer situation;
- Percentage of retreatment cases with sputum culture performed;
- Percentage of new cases on DOTS by total new cases, and
- Number of TB hospitalizations and average admission cost.

Mortality

- Crude TB mortality rate per 100,000 inhabitants. For this indicator analysis were included only deaths that had TB as a primary cause of death.

Results

TCP coverage and case detection

In 2010, 62.2% of Brazilian municipalities diagnosed at least one case, while in 2001 this figure was 48.9%. In 2001, primary care units notified 50.2% (19,181) of new smear positive cases. In 2010, this proportion rose to 56.3% (22,983), representing an annual increase of 2.1% on average in Brazil.

The variable "directly observed treatment performed" was included in Sinan in 2007. For this reason, DOTS coverage

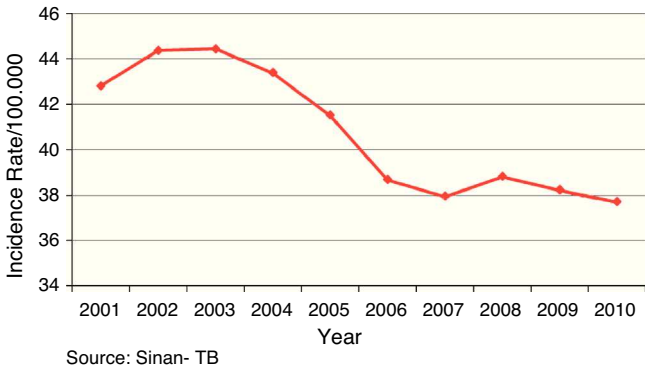

Fig. 1 – Tuberculosis crude incidence rate (Sinan-TB) – Brazil, 2001–2010. *Source*: Sinan-TB.

was analyzed from this year on. The number of health facilities that perform DOTS in Brazil increased from 1608 in 2006, which represented 30.1% of all units that have reported cases in the country, to 4745 (75.2%) in 2010. This represents an increase of 40.9% on average in the years studied.

The case detection rate in 2001 was 65% while 2010 showed the best value in the series, 88% (Table 1).

Morbidity

TB incidence in Brazil started to decline in 2003. It occurred a small increase in 2008, and continued to decline after words as seen in Fig. 1.

The incidence rate decreased on average 1.4% annually from 2001 to 2010. This decrease, however, did not occur evenly throughout the period, between regions or FS. In 2001, North and Northeast regions showed the highest incidence rates in the country, 51.2/100,000 inhab. and 46.0/100,000 inhab., respectively. With the exception of southern Brazil, all other regions showed a decline in the incidence rate over the 10 years of study. In 2010, Northern region showed the highest incidence rate in the country (45.7/100,000 inhab.) followed by Southeast (40.7/100,000 inhab.) (Table 2).

While incidence declined 5.0% on average per year in Tocantins, there was an average increase of 1.7% annually in Sergipe. 2001 was excluded for Minas Gerais state due to migration error in databases in Sinan on that year.

These rates also fluctuated substantially over the period studied. Almost all FS had fluctuations greater than 10% from one year to another, with the exception of Amazonas, Pará, Rio Grande do Norte, Pernambuco, Minas Gerais, Rio de Janeiro, São Paulo and Rio Grande do Sul. In 2010, Amazonas, Espírito Santo, São Paulo, Paraná, Santa Catarina and Distrito Federal showed opposite trends from the remaining states.

In 2010, the highest incidence rates occurred in Rio de Janeiro (70.7), Amazonas (67.7), Pará (47.5), Pernambuco (46.9) and Rio Grande do Sul (46.5) states. In that same year, the difference between the highest and the lowest rate registered in Rio de Janeiro (70.7 per 100,000 inhabitants) and Distrito Federal (11 per 100,000 inhabitants) was higher than six times (Table 2).

As can be seen in Table 3, new cases represented 82.7% (71,930) of all reported cases in 2010. That figure was 84.6% (73,797) in 2001. Compared to 2001, the observed values in 2010 decreased in almost all FS. In 2010, the proportion of new cases among all cases notified ranged from 89.8% (1624) in São Paulo to 76.2% (1061) in Paraíba.

In 2010, ten Brazilian FS concentrated more than 80% (57,806) of new TB cases in the country, São Paulo, Rio de Janeiro, Bahia, Rio Grande do Sul, Pernambuco, Minas Gerais, Ceará, Pará, Amazonas and Paraná. Rio de Janeiro and São Paulo themselves were responsible for 38.3% (27,559) of all new cases in the country in that same year.

Regarding demographic variables, it is observed that TB affects all population groups with predominance in males on working age. Men accounted for 63.9% (47,133) of all new cases in 2001. This proportion gradually increased until reached 66.1% (48,056) in 2009 and dropped again to 64.8% (47,546) in 2010. Tow age groups, 15–34 and 35–64 years old, concentrated more than 85% of new TB cases in the country in all the years studied.

The high number of missing records in variable "race/color" until 2006 made difficult to analyze this variable in the early years of the study. For this reason this variable was described from 2007 on. In 2010 when color was registered on more than 90% of cases, 53.6% (38,542) of new cases were brown or black and 35.1% (25,231) were white.

Regarding education, in 2001 about half the cases, 51.8% (38,230), had studied less than 8 years. Throughout the period the proportion of new cases illiterate and up to 8 years of study decreased on average 6.9% and 0.7% respectively between the years studied, while the category over 8 years of study showed an increase of 3.4% annually on average. It should be considered, however, the improvement in education among the whole Brazilian population in this period.

Table 3 shows that the proportion of new cases institutionalized in prisons increased from 3.8% (2726) in 2007 to 6.5% (4643) in 2010, an annual increase of 19.7% on average in the period.

The number of multidrug-resistant tuberculosis (MDR-TB) cases in 2010 was 607. This figure was 334 in 2001. This represents an annual increase of 8.1% on average in the number of MDR-TB cases in Brazil in the 10 years studied. This increase was particularly high between 2004–2005 and 2009–2010, with 22.6% and 47.3% increase from one year to another, respectively (Fig. 2). It is important to consider that in this last period NTP began to prioritize culture and sensitivity testing for all retreatment cases and for the most vulnerable populations.

The proportion of new TB cases HIV positive was 9.9% (7096) in 2010. Compared to 2001, which recorded 7.5% (5508) HIV-positive cases among all TB cases, there was an average annual increase of 3.2% in coinfection during the period studied (Table 4), reflecting the increase on HIV testing in recent years.

New pulmonary cases represented approximately 85% of the total cases reported in 2001 and these values remained almost constant until 2010 (Table 4).

Treatment and TCP performance

In 2001, 82.5% (52,245) of new pulmonary cases underwent microscopy sputum smear. This percentage has increased gradually until reached 86.5% (53,440) in 2010. New smear-positive cases accounted for 62.3% (39,460) of all new

Table 1 – TCP coverage and case detection – Brasil, 2001–2010.

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
TCP coverage										
Percentage of municipalities which diagnosed TB cases	48.9	60.1	62.1	62.2	64	64.2	63.1	64.1	63.7	62.2
Percentage of TB cases diagnosed in primary care facilities	50.2	52.0	54.1	55.1	55.6	56.9	56.2	55.6	56.7	56.3
DOTS coverage in health facilities	–	–	–	–	–	30.1	69.6	71.1	72.4	75.2
Case detection										
TB detection rate	65	77	74	83	81	79	78	82	86	88

Source: Sinan-TB, WHO.

pulmonary cases in 2001 and there was a slight increase in this figure over the period, reaching a value of 66.1% (40,820) in 2010 (Table 4).

With an inverse behavior from cure rate, the proportion of default decreased from 11.0% (8137) in 2001 to 9.0% (6881) in 2005. Then it remained almost constant until 2009, recording 10.0% (7324) that year. In 2010, default rate was 8.2% (5888), although outcome had 14.8% (10,643) of missing data in that year.

However, this trend was not homogeneous between federal states. While default decreased on average 8.8% annually in Distrito Federal, there was an average annual increase in treatment default of 14.0% in Roraima. In 2010, default rate ranged between 2.1% (6) in Distrito Federal and 10.6% (527) in Rio Grande do Sul. Among Brazilian states, Distrito Federal, Tocantins, Piauí and Acre, showed less than 5% of default in 2009. That same year, Minas Gerais, São Paulo, Pernambuco, Rondônia, Rio Grande do Sul, Maranhão and Rio de Janeiro showed default rates greater than 10%.

The proportion of treatment site transfers increased 2.1% annually on average between 2001 and 2010. In the years studied, São Paulo registered an average annual decrease of 12.4% and Acre an average annual increase of 59.4%. The proportion of treatment site transfers ranged from 0.9% (149) in São Paulo and 25.5% (49) in Amapá in 2010 (Table 5).

13.4% (11,661) of all cases reported in 2001 were retreatment. Half of those were relapse and half readmission after default, representing 6.8% (5957) and 6.5% (5704) respectively. These values remained almost constant over the period, and in 2010 the proportion of retreatment was 12% (10,405).

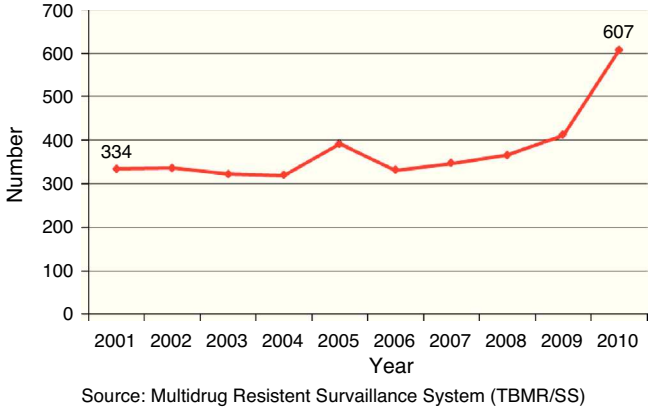

Fig. 2 – Number of multidrug resistant tuberculosis cases – Brazil, 2001–2010. *Source*: Multidrug Resistant Surveillance System (TBMR/SS).

Sputum culture in retreatment cases showed an average annual increase of 10.4% during the study period. The percentage of sputum culture tests conducted among retreatment cases in 2010 was 30.1% (2932) and in 2001 was 12.5% (1353) (Table 6).

Regarding retreatment cases outcome, in 2001, 51.1% (5957) cured, 21.6% (2523) were default, 8.1% (944) were transferred to another treatment site, and 0.3% (36) developed MDR-TB. These values remained almost constant over the period, with the exception of MDR-TB who presented an average annual increase of 21.3%. The proportion of missing data on closure got down 4.6% on average between 2001 and 2009, falling from 11.4% (1334) in 2001 to 6.5% (653) in 2009. In 2010, the proportion of missing data regarding closure was 19.5% (2030).

As can be seen in Table 4, the proportion of cases contained in the national database submitted to DOTS increased from 33.4% (28,744) in 2007 to 42.2% (36,763) in 2010. This represents an annual increase in the proportion of cases under DOTS of 8.2% on average.

In the 10 years studied, there were 180,363 hospital admissions duo to TB in Brazil, and this represented a 206 million dollars in hospital charges. In 2010, 16,153 hospital admissions were recorded in Brazil duo to all forms of TB, compared to 18,523 in 2001, representing an annual decrease of 1.0% on average. However, this trend was not uniform throughout the period, nor between FS. While São Paulo experienced an average annual decrease of 13.0% in TB hospitalizations during the study period, with 2020 admissions for TB in 2010, Sergipe had an average annual increase of 169.6%, with 43 admissions for TB in 2010. Santa Catarina, Paraná and Goiás also showed an average increase of more than 20% in hospital admissions for TB during the study period.

In 2001, São Paulo and Rio de Janeiro states alone concentrated 54.1% (10,027) of all admissions in the country for TB. In 2010, these states accounted for 27.5% (4200) of TB admissions. This decrease was mainly a decrease in the number of hospitalizations in the state of São Paulo. Paraná, Minas Gerais, Bahia, Pernambuco and Rio Grande do Sul in 2010 contributed over 5% each in the total of hospital admissions for TB in the country.

The average cost of hospital admissions duo to TB also varied over the years studied and between federal states.

Table 2 – Number of new cases and tuberculosis crude incidence rate (Sinan-TB) – Brazil and state of residence, 2001–2010.

Federate unit	Number of cases									
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Missing	540	682	748	887	821	31	50	59	57	56
North Region	6776	6890	6888	7117	6942	6893	6953	7014	7321	7252
Rondônia	561	536	548	532	541	448	473	481	571	477
Acre	325	305	305	278	267	352	282	274	322	307
Amazonas	2273	2105	2035	2135	2085	2164	2274	2380	2278	2360
Roraima	131	145	161	185	130	122	121	136	132	129
Pará	3024	3278	3410	3544	3477	3343	3351	3338	3597	3601
Amapá	194	252	211	224	230	230	244	233	220	192
Tocantins	268	269	218	219	212	234	208	172	201	186
Northeast Region	22,228	21,561	22,775	22,877	23,157	20,980	20,250	20,568	20,688	19,622
Maranhão	2637	2725	2623	2668	2760	2544	2478	2212	2163	2112
Piauí	1168	1103	1035	1102	1088	992	848	804	851	813
Ceará	3545	3593	3915	3855	3997	3525	3497	3838	3871	3631
Rio Grande do Norte	1041	1080	1128	1169	1083	997	926	1020	971	910
Paraíba	1137	1150	1186	1219	1214	991	1009	1074	1067	1061
Pernambuco	3810	4043	4309	4465	4433	4067	4081	4209	4202	4128
Alagoas	1141	1146	1196	1183	1258	1141	1177	1204	1187	1154
Sergipe	434	457	527	491	676	594	504	589	571	518
Bahia	7315	6264	6856	6725	6648	6129	5730	5618	5805	5295
Southeast Region	32,638	36,269	35,645	34,742	33,514	32,820	32,714	33,776	32,919	32,724
Minas Gerais	1187	5029	5152	5189	5044	4691	4686	4545	4254	3867
Espírito Santo	1335	1333	1321	1276	1270	1201	1259	1378	1274	1298
Rio de Janeiro	13,670	13,584	13,279	12,943	12,329	11,582	11,554	11,848	11,633	11,310
São Paulo	16,446	16,323	15,893	15,334	14,871	15,346	15,215	16,005	15,758	16,249
South Region	8203	8913	9214	8975	8741	8308	8748	8996	9151	9095
Paraná	2635	2800	2872	2616	2676	2437	2592	2540	2406	2393
Santa Catarina	1352	1526	1576	1516	1485	1540	1579	1670	1650	1730
Rio Grande do Sul	4216	4587	4766	4843	4580	4331	4577	4786	5095	4972
Center-West Region	3412	3181	3336	3096	3293	3181	3110	3185	3054	3181
Mato Grosso do Sul	838	767	880	863	895	778	825	888	897	820
Mato Grosso	1217	1055	1049	955	1119	1152	1017	1099	985	1186
Goiás	1012	1014	1034	935	921	873	860	844	887	884
Distrito Federal	345	345	373	343	358	378	408	354	285	291
Brazil	73,797	77,496	78,606	77,694	76,468	72,213	71,825	73,598	73,190	71,930

Federate unit	Incidence rate									
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Missing	–	–	–	–	–	–	–	–	–	–
North Region	51.2	51.0	50.0	50.6	47.2	45.9	45.3	46.3	47.7	45.7
Rondônia	39.8	37.4	37.6	35.9	35.3	28.7	29.7	32.2	38.0	30.5
Acre	56.6	52.0	50.8	45.3	39.9	51.3	40.1	40.3	46.6	41.9
Amazonas	78.4	71.1	67.1	68.9	64.5	65.4	67.1	71.2	67.1	67.7
Roraima	38.8	41.8	45.1	50.3	33.2	30.2	29.1	32.9	31.3	28.6
Pará	47.7	50.8	51.9	52.9	49.9	47.0	46.2	45.6	48.4	47.5
Amapá	38.9	48.8	39.5	40.5	38.7	37.4	38.3	38.0	35.1	28.7
Tocantins	22.6	22.3	17.7	17.5	16.2	17.6	15.3	13.4	15.6	13.4
Northeast Region	46.0	44.1	46.1	45.9	45.4	40.7	38.8	38.7	38.6	37.0
Maranhão	46.0	47.0	44.7	44.9	45.2	41.1	39.6	35.1	34.0	32.1
Piauí	40.7	38.1	35.4	37.4	36.2	32.7	27.7	25.8	27.1	26.1
Ceará	47.0	46.9	50.5	49.0	49.4	42.9	42.0	45.4	45.3	43.0
Rio Grande do Norte	37.0	37.9	39.1	40.0	36.1	32.8	30.0	32.8	30.9	28.7
Paraíba	32.8	32.9	33.7	34.4	33.8	27.4	27.6	28.7	28.3	28.2
Pernambuco	47.6	50.0	52.8	54.2	52.7	47.8	47.5	48.2	47.7	46.9
Alagoas	39.9	39.7	41.0	40.1	41.7	37.4	38.2	38.5	37.6	37.0
Sergipe	23.9	24.8	28.1	25.8	34.4	29.7	24.8	29.5	28.3	25.0
Bahia	55.4	47.0	51.0	49.6	48.1	43.9	40.7	38.7	39.7	37.8
Southeast Region	44.4	48.7	47.3	45.5	42.7	41.3	40.6	42.1	40.7	40.7
Minas Gerais	6.5	27.4	27.8	27.7	26.2	24.1	23.8	22.9	21.2	19.7
Espírito Santo	42.3	41.6	40.6	38.7	37.3	34.7	35.8	39.9	36.5	36.9
Rio de Janeiro	93.9	92.3	89.2	86.1	80.1	74.4	73.4	74.6	72.7	70.7

Table 2 – (*continued*).

Federate unit	Incidence rate									
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
São Paulo	43.7	42.8	41.1	39.1	36.8	37.4	36.5	39.0	38.1	39.4
South Region	32.2	34.6	35.4	34.1	32.4	30.4	31.6	32.7	33.0	33.2
Paraná	27.2	28.6	29.0	26.1	26.1	23.5	24.7	24.0	22.5	22.9
Santa Catarina	24.8	27.6	28.1	26.7	25.3	25.8	26.1	27.6	27.0	27.7
Rio Grande do Sul	40.9	44.1	45.3	45.6	42.2	39.5	41.3	44.1	46.7	46.5
Center-West Region	28.7	26.3	27.1	24.7	25.3	24.0	23.0	23.3	22.0	22.6
Mato Grosso do Sul	39.7	35.8	40.6	39.3	39.5	33.9	35.4	38.0	38.0	33.5
Mato Grosso	47.5	40.5	39.6	35.4	39.9	40.3	34.9	37.2	32.8	39.1
Goiás	19.8	19.5	19.5	17.3	16.4	15.2	14.7	14.4	15.0	14.7
Distrito Federal	16.4	16.1	17.0	15.4	15.3	15.9	16.8	13.8	10.9	11.3
Brazil	42.8	44.4	44.4	43.4	41.5	38.7	37.9	38.8	38.2	37.7

Source: Sinan-TB and Datasus.

In 2001, R$ 751.14 was the average cost for this kind of hospitalization in the country, and in 2010 that figure raised up to R$ 1478.93. There was an average annual increase of 8.2% on the average cost of hospitalization for TB in Brazil in the period. Sergipe, Goiás and Amazonas had an average annual increase of 25.3%, 21.9% and 19.3%, respectively, on the average cost of hospitalization due to TB (Table 7).

Mortality

Brazil has experienced an average annual decline in TB mortality rate of 2.9% between 2001 and 2010. In 2010, TB mortality rate was 2.4 deaths per 100,000 inhabitants. As the incidence rate, this trend was not uniform across states. While Paraná showed an annual decrease of 6.5% on average on mortality rate, Paraíba had an average annual increase of 10.9% in their rate.

Just as hospital admissions, São Paulo and Rio de Janeiro concentrated the majority of TB deaths in the country, accounting together for 43.3% (2349) of all deaths duo to TB in the country in 2001. This proportion has decreased over the study period, falling to 37.8% (1740) in 2010 (Table 8).

Discussion

According to key epidemiological and operational TB indicators analysis made in this article, many advances on tuberculosis control in Brazil were achieved in the last 10 years. It is important to say that Sinan database is updated monthly for HM. For this reason, indicators analyzed in this study may have significant change in value at the time of publication.

There was an increase in the number of municipalities that diagnosed and reported TB cases in the surveillance system. This result may infer the expansion of TB control programs coverage in the country, since diagnosis and reporting are primary activities of an implemented program. However, attention should be paid to about 40% of municipalities with no known cases of the disease, pointing to the existence of silent municipalities. The state programs should be aware of municipalities with this behavior so that disease surveillance failures can be identified and corrected.

In recent years Brazil showed a significant improvement in case detection rate when compared to WHO estimates. TB control decentralization to primary care can be a facilitator to diagnosis and information access. However, it must be consider that WHO's method of calculating estimated cases has changed over the series analyzed, which may have influenced this indicator improvement.[4]

The incidence rate is an indicator that measures the risk of illness of a given population in a given location and time. For TB, a chronic and difficult to treat disease, control requires actions shared with sectors outside health sector, which may explain the slight drop in annual incidence. This indicator behavior tends to be different between regions and states in the country, because it is influenced by implementation stage of TB control actions in the locality. Places where control actions are more consolidated tend to have more significant reduction. Political issues influence must also be raised, since successive changes in administrations, particularly in cities, leads to discontinuation in efforts and causes changes in TB indicators. However, fluctuations more than 10% from one year to another should be investigated, since it may indicate cases underreporting and compromise disease surveillance quality.

The highest TB incidence among males and young adults is a reality worldwide.[1] This profile, besides having the highest incidence, is the one with grater treatment default. Because most patients are in working age, access to diagnosis and treatment is complicated because working and health facilities opening hours usually match. To minimize this problem municipalities must create different strategies, such as alternative hours for primary care function and partnerships with patients' workplaces.

Analysis of "race," "education" and "closure" variables were hampered by missing fields. This problem was highlighted in several studies[5–7] as a limiting factor of any epidemiological analysis. Analysis of field completeness in Sinan should be a routine activity in surveillance to ensure variables reliability.

The collecting process of information of the variable "race," jeopardizes data reliability. In some places this variable is self-reported, while in others it is biased by health workers opinion who writes down information without patient knowledge. Even with the described limitations, black and brown

Table 3 – Tuberculosis cases profile according to sex, age, race, education, input in the information system and institutionalization status (Sinan-TB) – Brazil, 2001–2010.

TB cases profile	2001		2002		2003		2004		2005	
	n	%	*n*	%	*n*	%	*n*	%	*n*	%
Input in information system										
New case	73,797	84.6	77,496	83.5	78,606	83.8	77,694	83.6	76,468	83.8
Retreatment	11,661	13.4	11,930	12.8	11,100	11.8	10,761	11.6	10,116	11.1
Transfer from another unit	1579	1.8	3160	3.4	3708	4.0	4191	4.5	4488	4.9
Sex										
Male	47,133	63.9	49,545	63.9	50,235	63.9	49,947	64.3	49,369	64.6
Female	26,584	36.0	27,877	36.0	28,361	36.1	27,735	35.7	27,067	35.4
Age										
1–4 years old	1362	1.8	1345	1.7	1334	1.7	1217	1.6	1080	1.4
5–14 years old	2005	2.7	2113	2.7	2035	2.6	1931	2.5	1965	2.6
15–34 years old	30,460	41.3	31,277	40.4	31,816	40.5	31,560	40.7	30,972	40.5
35–64 years old	33,558	45.5	35,792	46.3	36,373	46.3	36,058	46.5	35,598	46.6
65 and plus	6306	8.6	6856	8.9	6937	8.8	6841	8.8	6790	8.9
Education										
Illiterate	8207	11.1	8886	11.5	8344	10.6	7818	10.1	7547	9.9
Up to 8 years	30,023	40.7	32,230	41.6	34,471	43.9	34,541	44.5	33,814	44.2
More than 8 years	11,013	14.9	14,570	18.8	16,792	21.4	18,052	23.2	17,895	23.4
Race										
Missing	65,414	88.6	49,404	63.8	29,477	37.5	23,781	30.6	22,472	29.4
White	3391	4.6	12,266	15.8	19,903	25.3	21,173	27.3	20,347	26.6
Black	863	1.2	4281	5.5	7542	9.6	8381	10.8	8038	10.5
Yellow	96	0.1	428	0.6	796	1.0	855	1.1	682	0.9
Brown	3715	5.0	10,532	13.6	20,135	25.6	22,836	29.4	24,318	31.8
Indian	318	0.4	585	0.8	753	1.0	668	0.9	610	0.8
Institutionalization										
Missing	–	–	–	–	–	–	–	–	–	–
Not institutionalized	–	–	–	–	–	–	–	–	–	–
Jail	–	–	–	–	–	–	–	–	–	–
Institutionalized but not in jail	–	–	–	–	–	–	–	–	–	–

TB cases profile	2006		2007		2008		2009		2010	
	n	%	*n*	%	*n*	%	*n*	%	*n*	%
Input in information system										
New case	72,213	83.6	71,825	83.5	73,598	83.7	73,190	83.7	71,930	82.7
Retreatment	9884	11.4	9903	11.5	10,127	11.5	10,020	11.5	10,405	12.0
Transfer from another unit	4128	4.8	4291	5.0	4173	4.7	4167	4.8	4625	5.3
Sex										
Male	46,761	64.8	46,930	65.3	48,271	65.7	48,056	66.1	47,546	64.8
Female	25,449	35.2	24,893	34.7	25,315	34.3	25,131	33.9	24,383	35.2
Age										
1–4 years old	1002	1.4	1034	1.4	965	1.3	1015	1.4	907	1.3
5–14 years old	1708	2.4	1773	2.5	1806	2.5	1752	2.4	1536	2.1
15–34 years old	29,045	40.3	28,903	40,3	29,872	40.6	29,895	40.9	29,173	40.6
35–64 years old	33,778	46.8	33,553	46.8	34,408	46.8	33,997	46.5	33,654	46.9
65 and plus	6595	9.1	6443	9.0	6447	8.8	6434	8.8	6545	9.1
Education										
Illiterate	5872	8.1	2985	4.2	3540	4.8	3584	4.9	3478	4.8
Up to 8 years	26,483	36.7	31,443	43.8	28,814	39.2	2789	38	26,322	36.6
More than 8 years	13,653	18.9	9651	13.4	11,944	16.2	12,841	17.5	12,757	17.7
Race										
Missing	17,660	24.5	13,361	18.6	11,649	15.8	7769	10.6	6732	9.4
White	20,532	28.4	22,567	31.4	24,150	32.8	25,346	34.6	25,231	35.1
Black	8210	11.4	8462	11.8	8948	12.2	9420	12.9	9176	12.8
Yellow	767	1.1	820	1.1	776	1.1	746	1.0	646	0.9
Brown	24,392	33.8	25,785	35.9	27,283	37.1	29,093	39.7	29,366	40.8
Indian	622	0.9	830	1.2	792	1.1	816	1.1	779	1.1

Table 3 – (*continued*).

TB cases profile	2006		2007		2008		2009		2010	
	n	%	*n*	%	*n*	%	*n*	%	*n*	%
Institutionalization										
Missing	–	–	23,870	33.2	17,292	23.5	3959	5.4	3565	5.0
Not institutionalized	–	–	42,924	59.8	50,571	68.7	62,533	85.4	61,664	85.7
Jail	–	–	2726	3.8	3445	4.7	4407	6.0	4643	6.5
Institutionalized but not in jail	–	–	2305	3.2	2290	3.1	2291	3.1	2058	2.9

Source: Sinan-TB.

colors accounted for the largest quantity of cases, as already demonstrated in literature.[8] Significant increase in cases of white color should be considered when analyzing data, suggesting an increased risk of illness over the years analyzed. Although in lesser extent, only approximately 1.1% of cases, Indian race is a cause of concern due to its high risk of illness and difficult diagnosis and treatment access.[3]

Variable "education status" is perhaps the only variable in Sinan that can be used as proxy of patient's socioeconomic status. Although it was not this study subject, an additional concern, beyond this group higher risk of getting ill, is that people with less education also have an increased risk of unfavorable outcomes, such as treatment default and death. Local strategies of social support through food baskets distribution and offset help aim to improve treatment adherence.

Recognition that prison people are more vulnerable to TB when compared to general population was important to raise the need of direct recommendations to this population group. Incorporation of the variable "incarcerated" in Sinan in 2007 already showed concern in quantifying this problem magnitude. Global Fund TB Project implementation in Brazil, with a working component directed to prison system, supported

Table 4 – Diagnosis and treatment variables analysis of new cases (Sinan-TB) – Brazil, 2001–2010.

New cases	2001		2002		2003		2004		2005	
	n	%	*n*	%	*n*	%	*n*	%	*n*	%
Pulmonary	63,336	85.8	66,256	85.5	67,209	86	66,423	85.5	65,684	85.9
Extrapulmonary	10,461	14.2	11,240	14.5	11,397	14	11,270	14.5	10,784	14.1
Sputum smear performed	52,245	82.5	54,705	82.6	55,732	83	55,129	83.0	55,490	84.5
Bacilliferous	39,460	62.3	41,416	62.5	42,044	63	41,471	62.4	41,801	63.6
Tested for HIV	19,034	25.8	21,967	28.3	24,175	31	25,633	33.0	28,274	37.0
HIV positive	5508	7.5	5941	7.7	6066	8	5830	7.5	5806	7.6
Investigated contacts	–	–	–	–	–	–	–	–	–	–
Cure	49,954	67.7	52,688	68.0	55,137	70	54,885	70.6	55,579	72.7
Default	8137	11.0	7649	9.9	7453	9	7182	9.2	6881	9.0
Transfer from another unit	5003	6.8	5599	7.2	6237	8	5981	7.7	5769	7.5
Death	58	0.1	54	0.1	83	0	95	0.1	273	0.4
Missing	6274	8.5	6670	8.6	4705	6	4689	6.0	3069	4.0
MDR TB	27	0.0	62	0.1	55	0	81	0.1	76	0.1
Cases under DOTS	–	–	–	–	–	–	–	–	–	–

New cases	2006		2007		2008		2009		2010	
	n	%	*n*	%	*n*	%	*n*	%	*n*	%
Pulmonary	62,006	85.9	61,529	85.7	62,994	85.6	62,707	85.7	61,784	85.9
Extrapulmonary	10,201	14.1	10,290	14.3	10,588	14.4	10,464	14.3	10,128	14.1
Sputum smear performed	52,691	85.0	52,753	85.7	54,116	85.9	53,866	85.9	53,440	86.5
Bacilliferous	40,442	65.2	40,341	65.6	41,276	65.5	40,667	64.9	40,820	66.1
Tested for HIV	29,646	41.1	33,542	46.7	37,346	50.7	40,127	54.8	42,056	58.5
HIV positive	5701	7.9	6415	8.9	6648	9.0	6815	9.3	7096	9.9
Investigated contacts	–	–	114,218	57.6	127,205	56.8	139,741	61.7	130,948	57.9
Cure	52,092	72.1	51,853	72.2	53,075	72.1	51,984	71.0	44,527	61.9
Default	6548	9.1	6799	9.5	7130	9.7	7324	10.0	5888	8.2
Transfer from another unit	4843	6.7	4638	6.5	4962	6.7	5343	7.3	5741	8.0
Death	1336	1.9	2543	3.5	2397	3.3	2309	3.2	2196	3.1
Missing	3353	4.6	2928	4.1	3075	4.2	2971	4.1	10,643	14.8
MDR TB	76	0.1	119	0.2	99	0.1	163	0.2	108	0.2
Cases under DOTS	–	–	28,744	33.4	31,135	35.4	32,716	37.4	36,736	42.2

Source: Sinan-TB.

Table 5 – New cases outcome (Sinan-TB) – Brazil and state of residence, 2001–2010.

Federate unit	2001			2002			2003			2004			2005		
	Cure	Default	Transfer	Cure	Default	Transfer	Cure	Default	Transfer	Cure	Default	Transfer	Cure	Default	Transfer
Missing	64.6	18.7	10.6	69.1	11.6	11.9	74.2	10.4	8.6	73.1	8.0	9.6	70.9	12.2	7.8
Rondônia	72.5	12.5	9.1	77.2	10.4	7.3	69.9	11.9	12.0	67.5	10.7	16.4	73.2	7.8	13.1
Acre	83.7	11.4	0.9	76.7	10.5	6.6	70.5	14.4	9.8	77.7	9.0	7.9	80.1	8.2	6.4
Amazonas	80.2	10.6	1.2	79.5	10.2	3.9	75.4	9.1	8.1	74.8	10.3	7.8	69.9	11.6	5.6
Roraima	82.4	4.6	6.9	81.4	4.8	6.9	83.2	2.5	8.1	85.4	2.7	6.5	83.1	3.8	6.2
Para	71.8	11.4	11.0	73.6	11.4	9.9	70.8	11.1	11.4	72.8	10.2	10.4	73.0	10.2	9.4
Amapá	64.9	16.0	11.9	61.9	15.1	10.3	63.5	10.4	10.4	65.6	11.2	11.6	60.4	10.0	13.5
Tocantins	69.4	8.6	14.2	73.6	11.2	10.8	67.4	8.7	20.6	74.9	6.8	15.5	72.2	5.7	16.5
Maranhão	70.4	12.3	10.6	71.7	12.3	9.9	68.3	11.9	12.6	68.3	10.8	14.6	71.4	6.7	15.6
Piauí	72.7	5.0	17.2	68.3	3.7	22.7	75.3	4.1	13.8	64.9	3.8	24.6	68.6	4.3	19.9
Ceara	73.3	6.3	4.2	61.8	6.6	4.8	72.0	7.8	6.7	72.9	7.4	5.2	74.6	7.7	6.6
Rio Grande do Norte	77.7	11.5	4.9	78.0	11.1	3.9	69.4	9.2	15.6	68.3	9.8	17.0	67.9	9.2	18.3
Paraíba	72.6	11.8	11.3	71.1	8.0	13.0	75.3	7.0	12.9	68.4	8.2	16.2	73.1	8.1	13.4
Pernambuco	64.1	15.4	8.0	65.3	12.5	12.2	64.4	11.0	13.9	67.1	10.4	12.5	67.4	10.4	12.4
Alagoas	76.2	11.7	6.3	71.9	10.4	12.0	72.2	9.6	12.3	75.1	10.7	7.7	78.5	9.4	4.9
Sergipe	81.6	10.1	3.7	83.8	6.6	2.4	82.5	5.9	5.9	78.6	10.6	5.5	70.9	6.5	14.8
Bahia	63.5	8.7	9.5	66.1	8.2	14.1	67.1	7.3	14.9	71.4	7.6	10.2	72.1	6.9	10.3
Minas Gerais	67.3	16.2	5.2	73.8	10.5	5.2	72.5	10.5	5.1	71.0	9.8	7.3	73.7	8.9	6.5
Espírito Santo	74.5	6.6	11.2	79.7	4.8	9.8	79.4	4.3	8.6	79.4	5.0	8.2	83.4	5.6	3.9
Rio de Janeiro	51.8	11.9	4.8	49.5	10.2	4.3	57.7	10.5	5.3	57.1	11.0	4.8	66.1	11.2	5.4
São Paulo	72.5	12.2	5.3	73.7	10.9	4.4	76.8	9.9	3.4	78.8	9.0	2.9	77.9	9.6	2.8
Paraná	73.9	10.6	5.4	75.7	7.8	6.7	73.9	7.5	7.9	70.7	8.1	9.8	75.5	6.6	7.7
Santa Catarina	71.4	10.4	4.4	74.6	7.7	6.7	75.1	8.7	6.9	76.8	9.7	5.6	77.3	7.1	7.3
Rio Grande do Sul	69.7	8.9	8.9	70.7	9.3	7.5	71.8	9.8	7.6	72.6	8.4	8.2	71.4	8.8	8.4
Mato Grosso do Sul	75.5	11.5	6.6	70.4	11.5	9.0	74.1	9.4	5.8	71.3	7.8	7.2	75.4	6.1	6.8
Mato Grosso	80.0	8.8	5.8	76.8	7.9	8.2	77.6	9.2	7.3	76.3	10.3	7.6	77.2	8.4	7.1
Goiás	71.1	10.0	11.1	74.2	10.3	8.6	69.3	10.3	10.8	65.5	10.3	13.3	68.9	9.2	12.1
Distrito Federal	86.4	7.0	3.2	85.2	6.1	1.7	84.7	5.9	2.7	86.0	4.4	2.9	83.5	5.6	5.6
Brazil	67.7	11.0	6.8	68.0	9.9	7.2	70.1	9.5	7.9	70.6	9.2	7.7	72.7	9.0	7.5

Table 5 – (*continued*).

Federate unit	2006			2007			2008			2009			2010		
	Cure	Default	Transfer	Cure	Default	Transfer	Cure	Default	Transfer	Cure	Default	Transfer	Cure	Default	Transfer
Missing	48.4	9.7	16.1	50.0	12.0	26.0	37.3	8.5	28.8	29.8	12.3	33.3	41.1	7.1	28.6
Rondônia	71.9	10.7	9.2	73.6	8.2	8.5	73.8	10.6	8.9	67.4	10.7	16.6	60.6	8.6	13.0
Acre	79.0	2.8	7.4	86.9	4.3	2.5	85.8	7.7	1.8	90.4	4.3	1.6	82.1	6.5	1.6
Amazonas	72.9	10.5	7.2	66.6	10.3	8.6	68.0	9.4	7.9	72.7	9.8	6.7	68.6	9.1	8.1
Roraima	67.2	5.7	9.0	88.4	2.5	5.0	79.4	5.1	5.1	82.6	8.3	3.8	78.3	4.7	6.2
Para	71.6	10.4	6.9	73.1	11.8	7.9	71.3	11.9	8.3	71.3	9.9	9.1	65.4	7.7	11.2
Amapá	56.5	16.1	11.7	68.9	12.3	13.9	63.9	11.2	17.2	65.0	10.0	19.1	47.9	9.9	25.5
Tocantins	76.1	1.3	16.2	74.5	4.3	11.5	75.0	4.7	10.5	72.1	4.0	11.9	58.1	2.2	15.1
Maranhão	70.1	7.4	13.2	72.2	6.8	14.2	73.7	8.6	10.8	70.8	11.4	10.0	61.9	9.4	10.1
Piauí	67.7	3.8	19.0	69.2	4.1	17.5	66.3	4.1	20.0	61.1	3.1	16.0	51.8	3.6	14.9
Ceara	76.4	7.2	6.8	78.5	7.7	6.6	76.6	8.1	7.2	72.5	8.7	9.3	59.1	7.4	8.4
Rio Grande do Norte	67.4	14.3	12.3	71.9	8.9	11.0	71.4	8.9	10.5	70.1	9.2	10.9	52.2	5.3	13.5
Paraíba	79.5	7.5	4.9	71.7	10.2	11.6	63.8	12.8	14.9	63.0	8.0	17.7	49.1	6.6	23.2
Pernambuco	68.9	8.1	12.2	68.8	9.2	10.1	65.2	11.3	11.6	60.4	10.4	12.9	47.8	8.3	12.9
Alagoas	78.9	8.9	4.1	77.2	8.3	4.6	74.1	10.0	6.9	68.5	10.0	9.1	57.0	8.6	13.2
Sergipe	71.9	9.8	12.3	77.8	13.3	3.6	74.9	14.1	3.9	74.3	9.8	5.6	75.7	7.7	5.0
Bahia	66.9	6.2	8.9	70.6	6.9	9.0	71.6	6.7	9.1	68.6	6.6	11.9	55.7	5.3	13.8
Minas Gerais	72.8	8.8	7.5	74.2	9.0	5.8	74.8	8.8	5.8	73.6	10.1	5.5	64.9	7.4	7.9
Espírito Santo	77.7	7.2	6.2	80.3	5.3	5.9	80.6	5.7	6.2	78.6	7.4	5.9	71.4	7.0	7.2
Rio de Janeiro	67.8	12.0	6.2	64.7	12.6	5.0	65.4	11.6	6.3	67.2	14.0	6.2	48.7	9.2	6.1
São Paulo	76.1	10.5	0.9	75.9	10.5	1.2	77.8	10.3	1.1	77.4	10.3	1.3	76.1	9.3	0.9
Paraná	73.5	7.0	7.3	73.2	7.1	8.9	73.5	8.4	7.7	71.9	7.4	7.5	65.9	6.6	8.1
Santa Catarina	76.7	6.1	8.1	75.2	6.8	8.9	73.3	8.2	8.7	75.0	7.1	7.8	67.1	5.7	12.9
Rio Grande do Sul	70.9	7.5	8.5	70.3	9.6	8.0	68.1	10.4	9.4	66.2	10.7	10.4	59.3	10.6	11.7
Mato Grosso do Sul	77.4	5.8	5.5	74.3	8.2	6.1	73.5	7.0	5.1	69.0	8.4	5.0	57.9	6.7	4.4
Mato Grosso	75.7	6.6	8.3	78.3	4.8	8.5	76.9	7.6	9.6	72.9	7.6	9.9	54.1	7.1	12.3
Goiás	65.2	8.9	10.9	70.3	8.6	11.2	73.0	7.9	9.4	70.9	8.7	7.7	57.6	6.0	10.2
Distrito Federal	81.7	3.2	6.6	85.5	2.5	5.1	82.2	3.7	9.9	86.3	2.5	5.3	76.3	2.1	8.6
Brazil	72.1	9.1	6.7	72.2	9.5	6.5	72.1	9.7	6.7	71.0	10.0	7.3	61.9	8.2	8.0

Source: Sinan-TB.

Table 6 – Diagnosis and treatment variables analysis of retreatment cases (Sinan-TB) – Brazil, 2001–2010.

Retreatment	2001		2002		2003		2004		2005	
	n	%	*n*	%	*n*	%	*n*	%	*n*	%
Relapse	5957	6.8	6293	6.8	5863	6	5626	6.1	5325	5.8
Readmission after default	5704	6.5	5637	6.1	5237	6	5135	5.5	4791	5.2
Culture performed	1353	12.5	1412	12.8	1457	14.2	1497	15.0	1582	16.9
Cure	5957	51.1	6016	50.4	5819	52	5636	52.4	5512	54.5
Default	2523	21.6	2495	20.9	2410	22	2313	21.5	2159	21.3
Death	11	0.1	10	0.1	12	0	27	0.3	72	0.7
Transfer from another unit	944	8.1	1001	8.4	1100	10	942	8.8	904	8.9
Missing	1334	11.4	1501	12.6	849	8	1001	9.3	661	6.5
MDR TB	36	0.3	55	0.5	55	0	66	0.6	77	0.8
Retreatment	2006		2007		2008		2009		2010	
	n	%	*n*	%	*n*	%	*n*	%	*n*	%
Relapse	5488	6.4	5202	6.0	5181	5.9	5037	5.8	5251	6.0
Readmission after default	4396	5.1	4701	5.5	4946	5.6	4983	5.7	5154	5.9
Culture performed	1846	20.1	2104	22.9	2300	24.5	2383	25.5	2932	30.1
Cure	5436	55.0	5186	52.4	5202	51.4	4799	47.9	4161	40.0
Default	2172	22.0	2335	23.6	2497	24.7	2561	25.6	2158	20.7
Death	277	2.8	451	4.6	432	4.3	455	4.5	355	3.4
Transfer from another unit	781	7.9	780	7.9	863	8.5	985	9.8	1156	11.1
Missing	580	5.9	622	6.3	635	6.3	653	6.5	2030	19.5
MDR TB	90	0.9	132	1.3	121	1.2	132	1.3	164	1.6

Source: Sinan-TB.

TNP to spread this topic importance, as well as training professionals in states and municipalities. This work result can be seen in figures, since gradual increase in incarcerated reported cases in Sinan suggests the problem has been recognized and worked more systematically in recent years. However, the link between Health and Justice Sectors remains a major challenge for disease control in the country.

TB/HIV cases require special attention, since they have higher risk of unfavorable treatment outcomes.[9] Increase in reported cases of coinfection seems to be related to increase on HIV testing among TB cases, which doubled over the years analyzed, although co-infection percentage did not increase in that same proportion. These data support the hypothesis that a few years ago, only one group of TB cases, perhaps the one possessing greatest risk on health workers judgment, were tested for HIV. Delay on returning test results to the health units and also on updating the surveillance system may be responsible for HIV testing figures lower than reality. The introduction of rapid HIV testing in health care system may have contributed to minimize this problem, since result comes out in minutes, allowing health workers to know almost immediately the patient's HIV status.

MDR-TB cases have higher probability of unfavorable outcomes, as well the possibility of adverse effects, beyond longer treatment when compared to sensitives.[1,10] Increase in number of MDR TB cases in the years studied appears to be associated with increase in culture testing in the same period, particularly in retreatment cases. MH recommends culture and sensitivity testing for all retreatment cases in order to identify drug resistance early, although culture testing is still very low. 30% of retreatment cases had culture done in 2010 and it has doubled when compared to 2001.

Increase on pulmonary cases that performed sputum smear on the evaluated years is a program quality indicator since as a consequence a smaller volume of cases will be treated without bacteriological confirmation. However, increase in active tuberculosis cases percentage cause concern, since they are responsible for the transmission chain maintenance and disease perpetuation. Diagnosing these cases early is an essential activity for TB control.

According to Freire,[11] the risk of case contacts developing TB, in a five years follow-up study, was 2300 cases per 100,000 contacts (4.6/1000 contacts/year). This finding reinforces the recommendation that all contacts should be investigated after a case diagnosis for other patients early identification and future cases prevention. Despite the variable "contacts investigated" had been inserted in Sinan in 2007, their inclusion did not have the same effect as the inclusion of the variable "institutionalized", since there was not a increase in contacts investigation in the 10 years analyzed. Some limiting factors such as fail in fulfilling the Record Books, fail in updating the information system with follow-up information and health

Table 7 – Hospital admissions duo to tuberculosis (SIH-SUS) – Brazil and state of residence, 2001–2010.

Federate unit	2001			2002			2003			2004			2005		
	n	%	Average value	*n*	%	Average value	*n*	%	Average value	*n*	%	Average value	*n*	%	Average value
Rondônia	169	0.9	455.3	120	0.6	437.3	175	0.8	448.6	158	0.8	489.6	132	0.7	584.7
Acre	104	0.6	478.3	139	0.7	598.4	136	0.6	729.4	107	0.5	774.4	106	0.6	679.6
Amazonas	291	1.6	504.1	277	1.4	524.8	661	3.2	733.3	884	4.3	866.8	874	4.7	1014.2
Roraima	60	0.3	465.4	55	0.3	528.7	54	0.3	555.3	42	0.2	663.4	40	0.2	634.4
Pará	640	3.5	501.2	591	3.0	518.5	595	2.8	540.0	627	3.1	646.7	463	2.5	693.3
Amapá	91	0.5	458.7	87	0.4	467.0	47	0.2	541.1	59	0.3	524.7	57	0.3	630.5
Tocantins	48	0.3	431.0	41	0.2	529.5	45	0.2	641.2	85	0.4	549.2	80	0.4	606.2
Maranhão	397	2.1	467.1	339	1.7	554.0	330	1.6	549.7	318	1.6	654.5	316	1.7	691.3
Piauí	151	0.8	431.1	271	1.4	561.0	254	1.2	549.9	175	0.9	577.8	236	1.3	649.7
Ceará	367	2.0	645.3	714	3.6	867.2	555	2.6	945.8	487	2.4	838.8	498	2.7	759.4
Rio Grande do Norte	236	1.3	570.1	287	1.5	653.8	281	1.3	623.1	302	1.5	697.8	238	1.3	903.0
Paraíba	414	2.2	546.3	492	2.5	615.0	555	2.6	719.0	526	2.6	723.9	525	2.8	697.3
Pernambuco	1057	5.7	717.9	1103	5.6	735.7	1235	5.9	598.6	1720	8.4	611.8	1308	7.1	976.1
Alagoas	102	0.6	464.8	258	1.3	570.0	307	1.5	639.1	281	1.4	846.9	326	1.8	898.1
Sergipe	2	0.0	400.0	29	0.1	902.5	35	0.2	1271.3	30	0.1	769.2	23	0.1	762.9
Bahia	895	4.8	590.9	802	4.1	702.5	820	3.9	643.9	1084	5.3	681.5	1364	7.4	839.4
Minas Gerais	1021	5.5	789.6	1481	7.5	879.7	1493	7.1	958.8	1470	7.2	1101.5	1459	7.9	1145.3
Espírito Santo	150	0.8	527.0	109	0.6	507.5	240	1.1	432.6	174	0.9	443.8	120	0.6	577.5
Rio de Janeiro	2491	13.4	819.4	2291	11.6	857.6	2288	10.9	839.7	2563	12.5	890.5	2279	12.3	896.8
São Paulo	7536	40.7	863.2	7197	36.4	880.1	6991	33.4	920.8	5780	28.3	945.0	5008	27.1	1005.4
Paraná	463	2.5	888.8	725	3.7	1101.2	833	4.0	1103.2	856	4.2	1275.4	654	3.5	1170.9
Santa Catarina	133	0.7	575.4	291	1.5	1051.0	276	1.3	1063.9	181	0.9	850.9	185	1.0	908.1
Rio Grande do Sul	759	4.1	733.2	1229	6.2	903.5	1608	7.7	975.9	1492	7.3	1051.6	1373	7.4	1056.1
Mato Grosso do Sul	297	1.6	766.7	284	1.4	788.0	403	1.9	795.0	340	1.7	823.9	317	1.7	838.4
Mato Grosso	222	1.2	511.1	200	1.0	561.8	199	0.9	534.7	176	0.9	581.8	110	0.6	705.1
Goiás	221	1.2	532.1	221	1.1	643.9	321	1.5	722.2	308	1.5	656.7	282	1.5	746.6
Distrito Federal	206	1.1	535.6	139	0.7	568.7	211	1.0	544.3	199	1.0	566.9	126	0.7	623.8
Brazil	18,523	100.0	751.1	19,772	100.0	814.6	20,948	100.0	832.8	20,424	100.0	869.2	18,499	100.0	938.7

Table 7 (*continued*). –

Federate unit	2006			2007			2008			2009			2010		
	n	%	Average value	*n*	%	Average value	*n*	%	Average value	*n*	%	Average value	*n*	%	Average value
Rondônia	104	0.6	630.3	98	0.6	632.7	62	0.3	105.5	93	0.6	239.0	117	0.7	148.8
Acre	95	0.6	637.1	144	0.9	680.2	94	0.5	202.3	121	0.8	377.5	80	0.5	450.4
Amazonas	359	2.1	701.0	277	1.8	886.1	284	1.6	495.3	300	1.9	572.4	453	2.8	1437.7
Roraima	41	0.2	679.1	39	0.3	756.2	36	0.2	223.6	28	0.2	254.5	50	0.3	444.4
Pará	428	2.5	635.2	379	2.4	693.4	449	2.5	786.5	475	3.1	1219.2	399	2.5	1231.2
Amapá	47	0.3	663.4	24	0.2	734.2	68	0.4	263.1	52	0.3	140.4	44	0.3	146.9
Tocantins	114	0.7	658.4	102	0.7	538.4	111	0.6	421.0	91	0.6	1065.7	87	0.5	877.0
Maranhão	290	1.7	654.1	263	1.7	651.3	327	1.8	524.5	175	1.1	288.8	167	1.0	445.2
Piauí	150	0.9	596.2	156	1.0	583.7	142	0.8	544.9	127	0.8	675.7	142	0.9	759.0
Ceará	607	3.6	729.8	562	3.6	739.1	556	3.0	839.1	700	4.5	1329.0	708	4.4	1121.4
Rio Grande do Norte	358	2.1	1039.5	299	1.9	1102.6	354	1.9	939.9	403	2.6	1507.6	428	2.6	1638.6
Paraíba	607	3.6	684.7	582	3.8	694.0	444	2.4	1279.0	536	3.5	1548.5	724	4.5	1598.3
Pernambuco	965	5.7	1006.7	999	6.5	1087.7	1648	9.0	1717.4	1354	8.8	1790.5	1470	9.1	1685.9
Alagoas	186	1.1	835.2	221	1.4	854.6	178	1.0	455.1	223	1.4	694.5	250	1.5	1168.9
Sergipe	72	0.4	1173.2	59	0.4	829.1	36	0.2	475.6	26	0.2	1243.3	43	0.3	724.4
Bahia	1255	7.4	909.3	1254	8.1	1084.8	1090	6.0	968.2	1161	7.5	1574.0	1369	8.5	1604.5
Minas Gerais	1485	8.8	1154.5	1203	7.8	1338.9	1461	8.0	1136.5	1384	9.0	1347.1	1302	8.1	1426.1
Espírito Santo	120	0.7	695.4	127	0.8	705.5	128	0.7	882.7	167	1.1	1114.9	143	0.9	1321.3
Rio de Janeiro	2166	12.8	932.6	2233	14.4	937.7	2243	12.3	776.5	2191	14.2	980.9	2180	13.5	1173.1
São Paulo	4584	27.1	973.7	4020	26.0	938.9	2715	14.9	1248.1	2050	13.3	1529.1	2020	12.5	1590.7
Paraná	633	3.7	1246.4	551	3.6	1328.8	2037	11.2	1265.5	961	6.2	2119.0	913	5.7	2150.8
Santa Catarina	252	1.5	1135.7	184	1.2	1170.3	330	1.8	1181.3	412	2.7	1607.9	422	2.6	1523.4
Rio Grande do Sul	1048	6.2	1022.1	952	6.1	995.1	1907	10.5	1232.3	1639	10.6	1773.9	1805	11.2	1782.7
Mato Grosso do Sul	367	2.2	964.5	323	2.1	867.8	313	1.7	1460.9	233	1.5	1793.5	279	1.7	1587.1
Mato Grosso	118	0.7	653.3	86	0.6	697.1	121	0.7	931.5	73	0.5	885.1	83	0.5	1478.0
Goiás	301	1.8	877.1	219	1.4	684.9	970	5.3	594.3	299	1.9	1520.9	346	2.1	1482.7
Distrito Federal	154	0.9	812.0	131	0.8	634.5	142	0.8	345.7	131	0.9	571.5	129	0.8	280.2
Brazil	16,906	100.0	940.1	15,487	100.0	962.3	18,246	100.0	1074.7	15,405	100.0	1416.8	16,153	100.0	1478.9

Source: Unified Health System Hospital Information System (SIH/SUS).

Table 8 – Number of deaths and crude mortality rate (SIM) – Brazil and state of residence, 2001–2010.

Federate unit	Number of deaths									
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Rondônia	35	37	46	32	30	28	25	34	20	27
Acre	26	19	21	18	27	23	28	16	16	15
Amazonas	117	106	102	88	104	107	96	113	133	110
Roraima	10	6	7	5	7	6	0	3	2	4
Pará	175	129	152	170	152	155	169	179	180	169
Amapá	11	10	6	6	11	11	11	7	9	13
Tocantins	13	7	7	14	13	15	19	11	14	12
Maranhão	121	125	116	159	181	179	168	196	192	186
Piauí	56	79	71	64	73	72	78	84	81	71
Ceará	256	232	191	214	232	264	253	269	276	239
Rio Grande do Norte	67	48	46	47	52	42	70	71	53	63
Paraíba	53	86	113	79	142	109	67	75	80	86
Pernambuco	422	401	427	436	398	379	418	403	397	354
Alagoas	79	89	89	70	76	83	85	95	99	91
Sergipe	34	26	30	39	41	43	35	35	45	39
Bahia	429	470	418	412	375	440	428	434	406	377
Minas Gerais	293	312	308	333	319	298	298	306	315	285
Espírito Santo	68	64	71	70	51	67	67	73	70	61
Rio de Janeiro	1030	961	889	910	789	848	825	870	815	889
São Paulo	1319	1158	1120	1053	928	970	921	910	922	851
Paraná	212	192	203	191	169	176	141	152	122	118
Santa Catarina	57	57	59	56	51	54	46	59	65	61
Rio Grande do Sul	308	314	276	281	277	242	275	290	273	258
Mato Grosso do Sul	58	63	62	68	66	57	48	59	67	66
Mato Grosso	94	95	70	76	86	80	87	78	82	98
Goiás	59	57	68	68	70	65	59	50	57	47
Distrito Federal	23	19	19	22	15	10	18	9	6	13
Brazil	5425	5162	4987	4981	4735	4823	4735	4881	4797	4603

Federate unit	Mortality rate									
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Rondônia	2.5	2.6	3.2	2.2	2.0	1.8	1.6	2.3	1.3	1.7
Acre	4.5	3.2	3.5	2.9	4.0	3.3	4.0	2.4	2.3	2.0
Amazonas	4.0	3.6	3.4	2.8	3.2	3.2	2.8	3.4	3.9	3.2
Roraima	3.0	1.7	2.0	1.4	1.8	1.5	0.0	0.7	0.5	0.9
Pará	2.8	2.0	2.3	2.5	2.2	2.2	2.3	2.4	2.4	2.2
Amapá	2.2	1.9	1.1	1.1	1.9	1.8	1.7	1.1	1.4	1.9
Tocantins	1.1	0.6	0.6	1.1	1.0	1.1	1.4	0.9	1.1	0.9
Maranhão	2.1	2.2	2.0	2.7	3.0	2.9	2.7	3.1	3.0	2.8
Piauí	1.9	2.7	2.4	2.2	2.4	2.4	2.5	2.7	2.6	2.3
Ceará	3.4	3.0	2.5	2.7	2.9	3.2	3.0	3.2	3.2	2.8
Rio Grande do Norte	2.4	1.7	1.6	1.6	1.7	1.4	2.3	2.3	1.7	2.0
Paraíba	1.5	2.5	3.2	2.2	3.9	3.0	1.8	2.0	2.1	2.3
Pernambuco	5.3	5.0	5.2	5.3	4.7	4.5	4.9	4.6	4.5	4.0
Alagoas	2.8	3.1	3.1	2.4	2.5	2.7	2.8	3.0	3.1	2.9
Sergipe	1.9	1.4	1.6	2.0	2.1	2.1	1.7	1.8	2.2	1.9
Bahia	3.2	3.5	3.1	3.0	2.7	3.2	3.0	3.0	2.8	2.7
Minas Gerais	1.6	1.7	1.7	1.8	1.7	1.5	1.5	1.5	1.6	1.5
Espírito Santo	2.2	2.0	2.2	2.1	1.5	1.9	1.9	2.1	2.0	1.7
Rio de Janeiro	7.1	6.5	6.0	6.1	5.1	5.4	5.2	5.5	5.1	5.6
São Paulo	3.5	3.0	2.9	2.7	2.3	2.4	2.2	2.2	2.2	2.1
Paraná	2.2	2.0	2.0	1.9	1.6	1.7	1.3	1.4	1.1	1.1
Santa Catarina	1.0	1.0	1.1	1.0	0.9	0.9	0.8	1.0	1.1	1.0
Rio Grande do Sul	3.0	3.0	2.6	2.6	2.6	2.2	2.5	2.7	2.5	2.4
Mato Grosso do Sul	2.7	2.9	2.9	3.1	2.9	2.5	2.1	2.5	2.8	2.7
Mato Grosso	3.7	3.6	2.6	2.8	3.1	2.8	3.0	2.6	2.7	3.2
Goiás	1.2	1.1	1.3	1.3	1.2	1.1	1.0	0.9	1.0	0.8
Distrito Federal	1.1	0.9	0.9	1.0	0.6	0.4	0.7	0.4	0.2	0.5
Brazil	3.1	3.0	2.8	2.8	2.6	2.6	2.5	2.6	2.5	2.4

Source: Mortality Information System (SIM).

workers misunderstandings about the concept of a contact investigated must be taken into consideration.

Cure and default rates are subject of major national and international targets. However, rates closest to reality may be only found in approximately 1.5 years after case diagnosis. Because treatment is long, deficiencies in following-up cases and as consequence in follow-up bulletins that update Sinan can be identified as possible causes of cases without closure maintenance. Some states are known to have, historically, rates equal or above of those recommended by WHO, but it is not a national reality. Variations between federal states can be express by health care models adopted, diagnosed cases complexity, health services organization and surveillance quality.

Treatment default is a major challenge in TB control today. Men, alcohol and drugs users, diabetics, coinfection cases, institutionalized cases and homeless people are recognized as vulnerable groups to default. For them, alternative strategies for follow-up should be performed. Aiming to contribute in reducing default and preventing MDR TB, MH changed his therapeutic regimen from three to four drugs and adopted the so-called fixed-dose combination (FDC) or "4 in 1", where four drugs are gathered into the same pill. This event marked a milestone for disease control in the country and it is expected that in a near future results can be measured.

Several studies have demonstrated DOTS effectiveness in TB cases.[12,13] The two indicators about DOTS analyzed tended to increase over the study period, but some points should be taken into account when interpreting these figures. Until 2010, health workers responsible for TB treatment interpreted DOTS concept in several different ways. Therefore, NTP has developed a more specific rule to consider a case to be under DOTS, and published in his manual of recommendations.[3] This change on DOTS concept should result in this indicator reduction over the next year making it closer to reality. In addition, in all cases DOTS is automatically filled by the system as performed, requiring upgrade if not performed. This procedure in Sinan may be overestimating these values.

Although in a small amount, the number of hospital admissions duo to TB decreased from 2001 to 2010. Hospitalizations duo TB may be associated with delay in diagnosis and irregular treatment, as well as cases that tend to develop more severe forms of the disease.[14,15] The increase in family health strategy coverage may be influencing reduction in hospitalizations, duo to expansion of access to diagnosis and treatments. Despite this national trend, some states had their hospitalizations increased. A possible explanation for Santa Catarina and Paraná states is the high number of TB/HIV coinfection cases when compared to other Brazilian states, which can cause serious complications leading to hospitalization. States that have high default rates also tend to have more hospitalizations due the disease, since these cases do not have treatment under control.

Regarding mortality from TB analysis, the country shows declining trend for over a decade, more pronounced until 2006. The cooling on the mortality drop can be explained by Ministry of Health strategy to reduce deaths due to unknown causes or poorly defined in that year. Due to this activity about 300 deaths each year have been attributed to TB after investigation. In 2011, Brazil achieved the STOP TB Partnership target to reduce mortality by 50% when compared to 1990. However, when analyzing mortality we should be alert to TB as associated cause in death, once in cases of coinfection, for example, AIDS remains the primary cause of death because criteria in causes of death classification. Underreporting deaths duo to or with TB in Sinan is a problem already explained in literature and need to be worked by states and municipalities.[15–17] The implementation of deaths duo to or with TB investigation routine may help reduce this problem since done systematically and with well-defined criteria.

Further advances can be described when we analyze the last 10 years of TB control in the country. The maintenance of TB as a priority on government political agenda, as well as maintaining epidemiological and operational TB indicators in major national agreements should be highlighted. The creation of metropolitan committees for fighting against TB as spaces of link between civil society and government in 11 metropolitan areas has allowed the expansion of partnerships for control actions. In the laboratory field, the introduction of real time molecular biology test, rapid test (validation in real conditions still undergoing) can provide greater agility in diagnosis.

For many years WHO took a expectancy position regarding tuberculosis control in Brazil, given the poor results obtained and the reluctance on the country's behavior to adopt WHO's recommendations. This attitude contrasted with recognition given to National STD/AIDS (DST/AIDS-NP) and Immunization (NIP) programs as international models. Since 2003, however, with tuberculosis control prioritization and its election as one of the Ministry of Health (MoH) priorities, WHO has demonstrated its recognition regarding national efforts.

Despite significant advances, many challenges must be overcome so eliminating TB as a public health problem goal can be achieved. When assessing the past we must say that improvement in indicators cannot be explained only by tuberculosis control program efforts. We must also consider TB social causes and prioritize mitigation of factors that increase some population segments vulnerability to the disease and promote actions that facilitate diagnosis access and treatment adherence.

Partnership with social movements and interaction with other sectors, particularly with social welfare, justice and institutions that work in promoting human rights, racial equality, combating the abuse of licit drugs (such as tobacco and alcohol) and illicit (especially crack), as well as liaison with legislature, to enable projects that benefit patients with tuberculosis and their families, with social support measures and inclusion in social programs, and facilitate access to health services. These steps are essential for more consistent results to be achieved in the medium and long term.

Conflict of interest

All authors declare to have no conflict of interest.

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