

# Knowledge and practices of medical students to prevent tuberculosis transmission in Rio de Janeiro, Brazil

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## Suggested citation

Teixeira EG, Menzies D, Cunha AJLA, Luiz RR, Ruffino-Netto A, Scartozzoni MS, Portela P, Trajman A. Knowledge and practices of medical students to prevent tuberculosis transmission in Rio de Janeiro, Brazil. *Rev Panam Salud Publica*. 2008;24(4):265–70.

## ABSTRACT

**Objectives.** To describe knowledge, practices, and associated factors of medical students to prevent transmission of tuberculosis (TB) in five medical schools.

**Methods.** Cross-sectional survey of undergraduate medical students in preclinical and in early and late clinical years. Information was obtained on sociodemographic profile, previous lectures on TB, knowledge about TB transmission, exposure to patients with active pulmonary TB, and use of respiratory protective masks.

**Results.** Among 1 094 respondents, 575 (52.6%) correctly answered that coughing, speaking, and sneezing can transmit TB. Early [adjusted odds ratio = 4.0 (3.0, 5.5)] and late [adjusted odds ratio = 4.2 (3.1, 5.8)] clinical years were associated with correct answers, but having had previous lectures on TB was not. Among those who had previous lectures on TB, the rate of correct answers increased from 42.1% to 61.6%. Among 332 medical students who reported exposure to TB patients, 194 (58.4%) had not used protective masks. More years of clinical experience was associated with the use of masks [adjusted odds ratio = 2.9 (1.4, 6.1)], while knowledge was inversely associated with the use of masks [adjusted odds ratio = 0.4 (0.2, 0.6)].

**Conclusions.** Many medical students are not aware of the main routes of TB infection, and lectures on TB are not sufficient to change knowledge and practices. Regardless of knowledge about TB transmission, students engage in risky behaviors: more than two-thirds do not use a protective mask when examining an active TB case. We suggest innovative, effective active learning experiences to change this scenario.

## Key words

Health knowledge, attitudes, practice; *Mycobacterium tuberculosis*; nosocomial infections, Brazil.

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Tuberculosis (TB) is a major public health concern worldwide (1). Brazil is ranked 16th among the 22 TB high-burden countries, with an annual inci-

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dence of 60 per 100 000 inhabitants (2). Rio de Janeiro State has the highest incidence (73 per 100 000 inhabitants per year) in Brazil (3). Nosocomial transmission of *Mycobacterium tuberculosis* has been well documented in several studies (4–6). Medical students and other health care workers are at increased risk for nosocomial *M. tubercu-*

losis infection in health care settings (7, 8). We recently reported an increased prevalence of latent TB infection among medical students in late clinical years in Rio de Janeiro (9).

In 1994, the Centers for Disease Control and Prevention (10) published guidelines for preventing the transmission of *M. tuberculosis* in health care facilities. In 2005, the guidelines were revised (11), reflecting shifts in the epidemiology of TB, advances in scientific understanding, and changes in health care practice. In 1998, a World Health Organization report on TB control and medical schools (12) was published. Among specific recommendations, knowledge, skills, and attitudes essential for a doctor to manage TB were stated.

The aim of this study was to evaluate knowledge about TB transmission, use of respiratory protective masks, and associated factors among undergraduate medical students in Rio de Janeiro State, Brazil.

## MATERIALS AND METHODS

### Study population

A cross-sectional study was performed among undergraduate medical students from March 2002 to September 2003. A self-administered questionnaire-based survey was carried out to evaluate knowledge about and practices regarding TB transmission.

The sample size was not calculated for this study; the study population was the same as described in a previous study (9). Brazil has 124 medical schools, 16 of which are in Rio de Janeiro State, with a total of 2 180 entrants each year (13). We included five medical schools in Rio de Janeiro State, with enrollment of 17% of the total medical student population in Rio de Janeiro State. Students were classified in three groups, according to the weekly duration of exposure to patients as stated in their curriculum. Students with fewer than 4 hours of contact per week with patients were classified as being in preclinical years; those with more than 4 hours of con-

tact per week were classified as being in early clinical years; and interns in full-time clinical rotations were classified as being in late clinical years.

The duration of these stages is slightly variable depending on the curriculum of each institution, but on average preclinical years last three or four semesters, early clinical years last four or five semesters, and late clinical years (internship) last three or four semesters. Students registered in preclinical and in early and late clinical years constituted the eligible population. All students who were 18 years of age or older and were present on the day the questionnaire was applied were enrolled after written consent. Those not willing to participate and those with active TB were excluded.

### Data collection and variables

The questionnaire contained information on the following variables: sociodemographic profile, previous health professional training, lectures attended regarding TB, exposure to active cases of pulmonary TB, type of health care setting where students were exposed to active cases of pulmonary TB, and use of respiratory protective masks. Knowledge about TB transmission was assessed with five questions, to be marked as true, false, or "I do not know": TB is spread by cough, by sneeze, by speech, by forks and knives, or by skin contact. The answer "I do not know" was considered an incorrect answer.

Students who marked the correct answer to the first three items were defined as knowledgeable about TB transmission. In theory, knowledge that speaking, sneezing, and coughing can spread TB would stimulate them to use protective masks. Consistent use of protective masks was defined as students who always used masks when exposed to an active case of pulmonary TB. Exposure to an active TB case was defined as the student's report of having examined at least one patient with active pulmonary TB.

Knowledge about TB and consistent use of masks were used as outcome

variables. Independent variables included age, sex, economic class, stage of medical studies, previous health professional training, and attending lectures on TB. Knowledge was also used as an independent variable for the analysis of mask use.

Economic class was categorized using the Brazilian Economic Classification Criterion (14). Subjects are classified in seven classes, from A1 (the highest) to E. In Rio de Janeiro, the general population was recently classified as A1 (mean monthly family income: U.S.\$2 500), 1%; A2 (U.S.\$1 500), 4%; B1 (U.S.\$900), 9%; B2 (U.S.\$540), 14%; C (U.S.\$270), 39%; D (U.S.\$140), 31%; E (U.S.\$70), 3%.

### Data analysis

Data obtained from the questionnaires were analyzed using SPSS 10.0 (SPSS Inc., Chicago, IL, USA). Mean values were compared by using Student's *t*-test. The  $\chi^2$  for trend test (Epi-Info 6.04d, Centers for Diseases Control and Prevention, Atlanta, GA, USA) was used to compare proportions for ordinal independent variables (early and late clinical years). The odds ratio was used as the measure of association between categorical independent variables and knowledge about TB transmission and mask use, and 95% confidence intervals were calculated.

Adjusted odds ratios and their 95% confidence intervals were calculated in a multivariate analysis using a binary logistic regression model, which included independent variables with statistical significance ( $P < 0.10$ ) in the univariate analysis.

### Ethics

The study was approved by the Ethical Committee of the University Hospital, Federal University of Rio de Janeiro (143/01). Authorization to conduct the study was obtained from the deans of all medical schools. The study was explained to all eligible students and those who agreed to participate signed an informed consent.

## RESULTS

Of 1 382 registered students, 269 did not volunteer to participate or were absent on the day of the survey and 19 others were excluded (18 were aged under 18 and one had active TB). A total of 1 094 students (79.2%) were enrolled in the study. Students were evenly distributed in the three categories of clinical experience, as shown in Table 1. As shown in Table 2, half the students knew that TB was transmitted by coughing, sneezing, and speaking.

In univariate analysis, knowledge of TB transmission was associated with early and late clinical years and having attended lectures on TB (Table 3), although the latter was not significant in multivariate analysis. Interaction between lectures on TB and clinical years was tested and found to have no significance. Among the 332 (30.3%) medical students exposed to an active pulmonary TB case, 303 informed where; of those, 282 (93.1%) had been exposed on an inpatient unit. Late clinical years and previous lectures on TB were as-

sociated with the reported use of protective masks in univariate analysis (Table 4). Conversely, knowledge about TB transmission was inversely associated with the use of protective masks (Table 4). In multivariate analysis, only late clinical years and knowledge about TB transmission were independently associated with the use of masks. Previous training in a National TB Program unit was reported by 23 (2.1%) of 1 094 students.

## DISCUSSION

In the present study, the most worrisome finding was the lack of knowledge about TB transmission, as only one-third of the students correctly answered all the questions about TB transmission. Although more years of clinical training was independently associated with knowledge about TB transmission, even in late clinical years, nearly half the students could not correctly answer how TB is transmitted. Lectures on TB added insufficient knowledge, as more than one-third still could not identify the main routes of TB transmission after lectures on TB.

In an extensive review of the medical literature including Medline and Lilacs databases, we found three studies about knowledge, attitudes, and practices of medical students regarding TB transmission. In a teaching hospital in Japan, between 1999 and 2001, a total of 2 159 physicians, nursing staff, medical technicians, pharmacists, clerks, and medical and dental students completed a questionnaire on their interest in and knowledge of TB, as well as their methods of learning about TB (15). Fewer than 50% of participants, including physicians, correctly answered basic questions about TB. The authors concluded that employees and students in this university hospital do not voluntarily learn about TB, or do not have enough knowledge about TB, and that the strengthening of health education on TB would be necessary. Our study corroborates these findings in the sense that an effort is needed to improve students'

**TABLE 1. Characteristics of 1 094 medical students who answered a questionnaire about knowledge and practices regarding tuberculosis (TB) transmission, Rio de Janeiro, Brazil, 2002–2003**

Characteristic <sup>a</sup>	n = 1 094	
	No.	%
Sex		
Female	561	51.3
Male	533	48.7
Economic level (mean monthly family income) <sup>b</sup>		
A1 (\$ 2 715)	246	22.5
A2 (\$ 1 619)	437	39.9
B1 (\$ 977)	219	20.0
B2 (\$ 581)	104	9.5
C (\$ 322)	58	5.3
D (\$ 147)	7	0.6
E (\$ 72)	0	0
Missing data	23	2.1
Clinical years		
Preclinical	350	31.9
Early clinical	405	37.0
Late clinical	339	30.9
Previous health professional training		
No	951	86.0
Yes	142	12.9
Missing	1	0.1
Previously attended lectures on TB		
Yes	597	54.6
No	484	44.2
Missing	13	1.2
Exposure to active TB cases		
In early and late clinical years		
Yes	327	43.9
No	333	44.8
Unknown/missing	84	11.3
In preclinical years		
Yes	5	1.4
No	310	88.6
Unknown/missing	35	10.0
Mask use among 332 students exposed to active TB cases		
Yes	138	41.6
No	159	47.9
Unknown/missing	35	10.5

<sup>a</sup> Mean age (years) ± standard deviation = 22.1 ± 2.8.

<sup>b</sup> Income is expressed in U.S. dollars.

**TABLE 2. Correctly answered questions about tuberculosis (TB) transmission among the 1 094 medical students who participated, Brazil, 2002–2003**

Answered correctly that TB is transmitted	<i>n</i> = 1 094	
	No.	%
Through cough of TB patients: yes	983	89.9
Through speech of TB patients: yes	623	56.9
Through sneeze of TB patients: yes	827	75.6
Through skin contact with TB patients: no	1 084	99.1
Through utensils used by TB patients: no	740	67.6
Through cough, sneeze, and speech of TB patients	575	52.6
Score of correct answers		
All 5 correct answers	370	33.8
Any 4 correct answers	356	32.5
Any 3 correct answers	251	22.9
Any 2 correct answers	113	10.3
Only 1 correct answer	4	0.4
No correct answer	0	0
Answered "I do not know" to all	77	7.0
Missing	19	1.7

knowledge about TB, in particular about TB transmission.

With regard to students' practices, one study in Canada, India, and Uganda (16) showed that knowledge score, patient exposure, and curriculum time were statistically significant positive

predictors of protective practice. Another study in China (17) reported that knowledge and practice competency regarding TB among final-year medical students were generally inadequate. The authors suggested that there is a lack of emphasis on proper health edu-

cation about TB and that medical students need more training and practice.

Two-thirds of our students did not use masks when examining a pulmonary TB patient. More years of medical school training was the only variable independently and directly associated with the use of protective masks. However, even among late clinical years, almost half the students did not use masks. Attendance at lectures on TB was not associated with knowledge and, interestingly, knowledge was inversely associated with the use of masks. This surprising finding is difficult to explain. Lack of association between knowledge and health practices is widely reported in the literature (18).

Although our objective was not to assess learning strategies, we confirmed that only a very small proportion of students reported training in national TB programs. Instead, almost all students who reported contact with active pulmonary TB patients did so within hospitals—giving rise to concerns about nosocomial transmission

**TABLE 3. Factors associated with knowledge that tuberculosis (TB) is transmitted by cough, sneeze, and speech among 1 094 medical students, Brazil, 2002–2003**

Characteristic	At least 1 incorrect answer ( <i>n</i> = 519)		All 3 correct answers ( <i>n</i> = 575)		OR <sup>a</sup> (95% CI) <sup>c</sup>	aOR <sup>b</sup> (95% CI)
	No.	%	No.	%		
Sex						
Male	267	50.1	266	49.9	1	1
Female	252	44.9	309	55.1	1.2 (0.97, 1.6)	1.3 (0.99, 1.6)
Economic class (US\$) <sup>d</sup>						
322/147	33	50.7	32	49.2	1	
715/619/977/581	473	47.0	533	52.9	1.6 (0.7, 1.9)	NA <sup>e</sup>
Missing	13	56.5	10	43.5	... <sup>f</sup>	
Clinical years						
Preclinical	246	70.3	104	29.7	1	1
Early clinical	150	37.0	255	63.0	4.0 (3.0, 5.5)	4.0 (3.0, 5.5)
Late clinical	123	36.3	216	63.7	4.2 (3.0, 5.7)	4.2 (3.1, 5.8)
Previous health professional training						
No	456	47.9	495	52.1	1	
Yes	63	44.4	79	55.6	1.2 (0.8, 1.7)	
Missing	0	0	1	100	...	NA
Previous lectures on TB						
No	279	57.6	205	42.4	1	1
Yes	229	38.4	368	61.6	2.2 (1.7, 2.8)	0.9 (0.6, 1.3)
Missing	11	84.6	2	15.4	...	...

<sup>a</sup> OR = odds ratio.

<sup>b</sup> aOR = adjusted odds ratio.

<sup>c</sup> CI = confidence interval.

<sup>d</sup> Mean monthly family income, expressed in U.S. dollars.

<sup>e</sup> NA = not applicable.

<sup>f</sup> ... = blank.

**TABLE 4. Use of mask among 332 medical students exposed to active pulmonary tuberculosis (TB) cases, Brazil, 2002–2003**

Characteristic	Did not always use mask (n = 194)		Always used mask (n = 138)		OR <sup>a</sup> (95% CI) <sup>c</sup>	aOR <sup>b</sup> (95% CI)
	No.	%	No.	%		
Sex						
Male	94	58.0	68	42.0	1	
Female	100	58.8	70	41.2	0.9 (0.7, 1.6)	NA <sup>d</sup>
Economic class (US\$) <sup>e</sup>						
C/D	8	47.1	9	52.9	1	
A1/A2/B1/B2	182	58.7	128	41.3	0.6 (0.2, 1.8)	NA
Missing	4	80.0	1	20.0	... <sup>f</sup>	
Clinical years <sup>g</sup>						
Early clinical	41	78.8	11	21.2	1	1
Late clinical	153	55.6	122	44.4	2.9 (1.4, 6.4)	2.9 (1.4, 6.1)
Previous health professional training						
No	170	57.6	125	42.4	1	
Yes	24	64.9	13	35.1	0.7 (0.3, 1.6)	NA
Previous lectures on TB						
No	22	81.5	5	18.5	1	1
Yes	171	56.4	132	43.6	3.4 (1.2, 10.5)	0.9 (0.3, 3.8)
Missing	1	50.0	1	50.0	...	...
Correctly answered that cough, sneeze, and speech transmits TB						
No	52	43.3	68	56.7	1	1
Yes	142	67.0	70	33.0	0.4 (0.2, 0.6)	0.4 (0.2, 0.6)

<sup>a</sup> OR = odds ratio.<sup>b</sup> aOR = adjusted odds ratio in the final model of logistic regression multivariate analysis<sup>c</sup> CI = confidence interval.<sup>d</sup> NA = not applicable.<sup>e</sup> Mean monthly family income, expressed in U.S. dollars.<sup>f</sup> ... = blank.<sup>g</sup> Five students in preclinical years who examined TB cases were excluded from this analysis.

and inadequate settings for TB practice already reported in other studies (19). Taken together, these findings suggest that effective changes in medical education are necessary to result in actual changes in behavior. Field practice and alternative active learning processes such as students' scientific leagues should be encouraged in medical and nursing schools and their effectiveness on students' knowledge and practices need to be evaluated (20).

Our study has a few limitations. Students' attitudes were not evaluated. Previous studies on risky behavior have shown that knowledge does not change practices (18). It would have been important to understand these students' motivations for the use of protective masks. In addition, nearly 20% of eligible students were not included in the study. Although data on their characteristics are not available, there is no reason to think that their inclusion would substantially change

our findings. On the other hand, according to official Brazilian Ministry of Education statistics (<http://www.inep.gov.br>), students included in this study have a representative socioeconomic and educational profile with regard to the 16 medical schools in Rio de Janeiro.

In conclusion, medical students in Rio de Janeiro State have poor knowledge about TB transmission and engage in risky behavior when dealing with exposure to *M. tuberculosis* infection during their studies. Apparently, lectures and knowledge are not sufficient to build good attitudes and good practices. No policies, funding, or research will get us closer to the 8th Millennium Development Goals—which include fighting AIDS, malaria, and TB—without proper training of our health care workforce, which must lead the way for empowering society in a large-scale confrontation of the epidemic. The agenda of leading inter-

national TB institutions must include TB education and students' engagement in fighting TB.

**Acknowledgments.** The authors thank the staff of the 7th ward of Santa Casa da Misericórdia do Rio de Janeiro General Hospital, the students of the scientific program of the involved institutions, and the students of the Rio de Janeiro Tuberculosis Scientific League. The authors acknowledge the Brazilian Ministry of Science and Technology (Institutos do Milênio/62.00055/01-4-PACDT-RedeTB project); the ABC Training Grant for Rio de Janeiro (ICIDR) Program, Fogarty International Center, National Institutes of Health (Grant D43TWO5574-04); and the International Clinical, Operational and Health Services Research Training Award in AIDS and Tuberculosis (ICOHRTA AIDS/TB, FIC/NIH # 5U2 R TW006883-03) for supporting this study.

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Manuscript received on 27 February 2007. Revised version accepted for publication on 16 April 2008.

## RESUMEN

## Conocimientos y prácticas de los estudiantes de medicina para prevenir la transmisión de la tuberculosis en Río de Janeiro, Brasil

**Objetivos.** Describir los conocimientos y las prácticas de los estudiantes de medicina para prevenir la transmisión de la tuberculosis (TB) en cinco escuelas de medicina y sus factores asociados.

**Métodos.** Estudio transversal mediante encuesta a estudiantes de medicina de cursos preclínicos, clínicos iniciales y clínicos avanzados. Se obtuvo información del perfil sociodemográfico, las conferencias recibidas sobre TB, el conocimiento sobre la transmisión de la TB, la exposición a pacientes con TB pulmonar activa y el uso de máscaras respiratorias de protección.

**Resultados.** De los 1 094 encuestados, 575 (52,6%) respondieron correctamente que toser, hablar y estornudar pueden transmitir la TB. Estar en los cursos clínicos iniciales (razón de posibilidades ajustada [ORa] = 4,0; intervalo de confianza de 95% [IC95%]: 3,0 a 5,5) y avanzados (ORa = 4,2; IC95%: 3,1 a 5,8) se asociaron con las respuestas correctas, no así haber recibido conferencias sobre TB. La tasa de respuestas correctas aumentó de 42,1% a 61,6% en los estudiantes que habían recibido conferencias sobre TB. De los 332 estudiantes de medicina que informaron haber estado expuestos a pacientes con TB, 194 (58,4%) no usaron máscaras protectoras. El mayor número de años de experiencia clínica se asoció con el uso de máscaras (ORa = 2,9; IC95%: 1,4 a 6,1), mientras que el conocimiento sobre el tema se asoció inversamente con el uso de máscaras (ORa = 0,4; IC95%: 0,2 a 0,6).

**Conclusiones.** Muchos estudiantes de medicina no conocen las vías principales de infección de la TB y las conferencias sobre TB no son suficientes para modificar sus conocimientos y actitudes. Independientemente del conocimiento sobre la transmisión de la TB, los estudiantes incurrieron en conductas de riesgo: más de dos terceras partes no usó máscaras protectoras al examinar casos activos de TB. Se recomienda establecer prácticas docentes innovadoras, efectivas y activas para cambiar este escenario.

## Palabras clave

Conocimientos, actitudes y prácticas en salud; *Mycobacterium tuberculosis*; infección hospitalaria; Brasil.