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Knowledge, practices and attitudes of the programmatic management of tuberculosis among Colombian medical students

Conocimientos, prácticas y actitudes del manejo programático de la tuberculosis en estudiantes de medicina de Colombia

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ABSTRACT:

Background: The tuberculosis is an infectious disease with high disease burden in Colombia, so medical education is expected to be standard in all regions and medical students have competencies in the operative management of tuberculosis. This study evaluated the knowledge, attitudes, and practices in tuberculosis in medical students in Colombia and related factors.
Methods: Questionnaire for the evaluation of knowledge, attitudes, and practices in tuberculosis in medical students in Colombia, who were in clinical semesters and were registered at the 2020 annual meeting of the Asociación de Sociedades Científicas de Estudiantes de Medicina de Colombia (ASCEMCOL) to establish the level of knowledge in tuberculosis.
Result: The study found that students from regions with a higher burden of disease, such as the Eje Cafetero had higher scores that those from other regions. On the other hand, it was observed that the student´s own experience in tuberculosis screening (tuberculin skin test PPD – Mantoux) and the clinical experience in care patients with tuberculosis are related to the knowledge of the programmatic management of tuberculosis.
Conclusions: The study shows a low level of knowledge, attitudes, and practices of programmatic management of tuberculosis in medical students in clinical semester in Colombia.

Keywords: Medical education, tuberculosis, knowledge, Colombia, clinical competence, medical students

RESUMEN:

Introducción: La tuberculosis es una enfermedad infecciosa con alta carga de la enfermedad en Colombia, por lo que se espera que la educación médica sea estándar en todas las regiones y los estudiantes de medicina tengan competencias en el manejo operativo de la tuberculosis. Este estudio

evaluó los conocimientos, actitudes y prácticas en tuberculosis en estudiantes de medicina de Colombia y los factores relacionados.
Métodos: Cuestionario de evaluación de conocimientos, actitudes y prácticas en tuberculosis en estudiantes de medicina en Colombia, que cursaban semestre clínico y se encontraban inscritos en la reunión anual 2020 de la Asociación de Sociedades Científicas de Estudiantes de Medicina de Colombia (ASCEMCOL) para establecer el nivel de conocimientos en tuberculosis.
Resultados: Se evidenció que los estudiantes de regiones con mayor carga de la enfermedad como el Eje Cafetero presenta puntajes más altos de forma diferencial a las otras regiones. Por otra parte, se observó que la experiencia propia del estudiante en el tamizaje para tuberculosis (prueba cutánea de la tuberculina PPD - Mantoux) y la experiencia en la atención de pacientes con tuberculosis en el entorno clínico están relacionadas a los conocimientos del manejo programático de la tuberculosis.
Conclusión: El estudio demuestra bajo nivel de conocimientos, actitudes y prácticas del manejo programático de la tuberculosis en los estudiantes de medicina que cursaban semestres clínicos en Colombia.

Palabras clave: Educación médica, tuberculosis, conocimientos, Colombia, competencias clínicas, estudiantes de medicina.

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Clinical Research Center of the Fundación Valle del Lili University Hospital, provided the professional resource to develop the research project, together with the participation of the students of the Icesi University - Cali.

INTRODUCTION

Tuberculosis (TB), an infectious disease, has a high disease burden and is one of the ten leading causes of death in the world[1]. Approximately 95% of tuberculosis cases and deaths occur in low- and middle-income countries[2]. Colombia is a middle-income country with marked social inequality[3], and the incidence rate of TB for 2018 was 26.9 cases per 100,000 inhabitants[4], which indicates that tuberculosis is endemic in the country[5].

The programmatic management of TB in Colombia must be carried out at the first level of health care, and the responsibility for patient management is shared among the agents of the health system, i.e., general practitioners participate in TB programs at institutions that provide health services[6].

In 2016, the General Council of Medical Education formed the Commission for the Transformation of Medical Education in Colombia[7]; one of its commitments is a common core curriculum for medical schools[8]. The TB curriculum was developed in 2003[9], for which only TB diagnostic competence, treatment and rehabilitation are required for training general practitioners, with no clear guidance on how these achievements will be evaluated.

Therefore, it is expected that medical education in Colombia regarding TB should be standardized in all regions and that general practitioners will have adequate professional competencies to contribute to the global End TB Strategy 2015-2035; however, these assumptions have not been evaluated nationally[10]. Previous studies on TB competencies in health workers and students in specific regions of the country[11,12] and in regions of the world with a high disease burden, e.g., Asia and Latin America[13–16],have indicated poor performance. Furthermore, a baseline of the knowledge, attitudes, and practices among Colombian medical students is currently unknown.

In this study, a questionnaire was applied to evaluate TB knowledge, attitudes and practices among medical students in Colombia, who were participating in clinical rotations and who attended the 2020 annual meeting of the Asociación de Sociedades Científicas de Estudiantes de Medicina de Colombia (ASCEMCOL).

METHODS

This was an analytical cross-sectional study, in which medical students voluntarily participated by completing an online questionnaire (carried out using this modality due to the health emergency caused by COVID-19), after virtually signing an informed consent form.

The questionnaire was developed by the infectious disease team of Hospital Universitario Fundación Valle del Lili in Cali. The following sociodemographic characteristics and exposures of interest were collected: type of university, geographic region of study, basic clinical semester (semesters 5-8) and advanced clinical semester (semesters 9-12), exposure to screening test (tuberculin skin test PPD - Mantoux), experience with personal protection elements and care for patients diagnosed with TB. Knowledge, attitudes and practices in programmatic management were evaluated using the following constructs: Epidemiology (5 questions - 20%), Clinic (2 questions - 8%), Diagnosis (3 questions - 12%), Treatment (5 questions - 20%) and Operational Management (10 questions - 40%). The cutoff point for adequacy was 60% correct answers when evaluating by construct and weighted global score.

Medical students who were participating in clinical rotations and who attended the annual meeting of the Asociación de Sociedades Científicas de Estudiantes de Medicina de Colombia (ASCEMCOL) in 2020 were eligible to complete the questionnaire. The sample size was calculated in Epidat 4.2 using the following parameters: total of 2,600 students, 90% statistical power, 17% expected knowledge, 95% confidence level, and 20% nonresponse; the estimated sample size was 240 students. Only 100 students completed the questionnaire.

The study was approved by the ethics committee of Hospital Universitario Fundación Valle del Lili, act No. 25 of December 4, 2019. The participants were ensured that their responses would be confidential, anonymous and safely guarded.

Statistical analysis was performed with STATA® version 14. The descriptive analysis includes absolute and relative frequencies and means and standard deviations of categorical variables with a normal distribution. The association between sociodemographic variables and exposures of interest in relation to adequacy in each construct was evaluated by Pearson's chi-squared test. The normality of the weighted global score was evaluated using the Shapiro-Wilks test; because the data had a normal distribution, Student's t test and ANOVA were performed to compare the averages of global weighted scores between exposures of interest for two categories. Finally, the magnitude of the association between adequacy in the constructs and the exposures of interest was estimated using ORs with 95% confidence intervals, with an a priori significance value of 5%, and logistic regression was conducted for regions and knowledge constructs, using the Eje Cafetero as the reference region.

RESULTS

The sociodemographic characteristics, level of knowledge and experiences during academic training for the students and the adequacy results for the knowledge constructs are presented in Table 1.

More women than men participated, and one in two students was under 21 years of age. Fifty-five percent of the students were enrolled in private universities, and the region Eje Cafetero and the Pacífico were the main areas where the students were studying. Fifty-three percent of the students were in advanced clinical semesters (Table 1).

The majority of students affirmed having received TB education in their training and reported the ability to interpret PPD tests, and 39% of the students had been screened for PPD. Seventy-two percent of the students reported experience in the care of TB patients, 69% perceived the occupational risk of TB infection during care, and 71% correctly identified personal protection elements for TB care (Table 1).

Table 1 Sociodemographic characteristics, exposures of interest, knowledge of programmatic management and student learning preferences

Variable	**n (%)**	
Sex: n (%)	Female 66 (66%)	Male 34 (34%)
Article I. Age: Median (Interquartile Range)	**Article II.**	**21 (21-23)**
Type of university: n (%) Public	Public 45 (45%)	Private 55 (55%)
Geographic region *: n (%) Caribe Centro Oriente Centro Sur Eje Cafetero Llano Pacifico	7(7%) 14 (14%) 11 (11%) 33 (33%) 1 (1%) 34 (34%)	
Clinical semester completed: n (%) Basic clinical (semesters 5-8) Advanced clinical (semester 9-13)	47 (47%) 53 (53%)	
General questionnaire: n (%)	No	Yes
Received education in tuberculosis during academic training	4 (4%)	96 (96%)
Taken a PPD test during academic training	61 (61%)	39 (39%)
Knowledge in the interpretation of tuberculin tests - PPD	16 (16%)	84 (84%)
Experience in caring for patients diagnosed with tuberculosis	28 (28%)	72 (72%)
Proper use of personal protection elements with regard to tuberculosis	29 (29%)	71 (71%)
Perception of the risk of infection during care	31 (31%)	69 (69%)
Assessment of knowledge regarding tuberculosis - Constructs: n (%)	Not approved	Approved
Epidemiology	31 (31%)	69 (69%)
Clinic	16 (16%)	84 (84%)
Diagnosis	11 (11%)	89 (89%)
Treatment	27 (27%)	73 (73%)
Operational management	50 (50%)	50 (50%)
Weighted overall score	54 (54%)	46 (46%)

* The different regions of Colombia according to DANE (Departamento Administrativo Nacional de Estadística).

The evaluation of knowledge by construct shows acceptable knowledge in Epidemiology and adequate knowledge in Clinic, Diagnosis and Treatment but low approval in Operative Management. However, the overall weighted adequacy of knowledge was low, i.e., 46%. The responses for each of the questions regarding the programmatic management of TB are provided in (Table 2).

Table 2 Assessment of knowledge in the programmatic management of tuberculosis

Construct	Questions	Not adequate (%)	Adequate n (%)
Epidemiology	1. Identification of mycobacteria that are part of the M. tuberculosis complex	55 (55%)	46 (46%)
	2. Route of transmission of tuberculosis	-	100(100%)
	3. Incidence of tuberculosis in Colombia	66 (66%)	34 (34%)
	4. Departments with the highest tuberculosis burden in Colombia	68 (68%)	32 (32%)
	5. Population most at risk of developing tuberculosis	11 (11%)	89 (89%)
Clinic	6. Classic triad of symptoms of pulmonary tuberculosis infection	7 (7%)	93 (93%)
	7. Definition of respiratory symptoms	11 (11%)	89 (89%)
Diagnosis	8. Tuberculin test or PPD is a confirmatory test for tuberculosis	10 (10%)	90 (90%)
	9. Staining for the identification of acid-fast bacilli (AAB)	3 (3%)	97 (97%)
	10. Gold test for the diagnosis of tuberculosis	61 (61%)	39 (39%)
Treatment	11. Useful drugs for the treatment of tuberculosis	28 (28%)	72 (72%)
	12. Identification of category I drugs for tuberculosis treatment	5 (5%)	95 (95%)
	13. Therapeutic scheme for drug-sensitive tuberculosis	46 (46%)	54 (54%)
	14. Bactericidal drugs for tuberculosis	49 (49%)	51 (51%)
	15. Drugs with high hepatotoxic potential	66 (66%)	34 (34%)
Operational Management	16. Definition of multidrug resistant mycobacterium	44 (44%)	56 (56%)
	17. Definition of widely resistant mycobacterium	25 (25%)	75 (75%)
	18. Definition of successful treatment	31 (31%)	69 (69%)
	19. Pharmacokinetics of tuberculosis treatment	44 (44%)	56 (56%)
	20. Periodicity of controls in tuberculosis by general medicine	60 (60%)	40 (40%)
	21. Control by general medicine after treatment	71 (71%)	29 (29%)
	22. Periodicity of tuberculosis controls by specialist	65 (65%)	35 (35%)
	23. Criteria for evaluation by a committee for special cases	18 (18%)	82 (82%)
	24. Periodicity of performing a tuberculin test or PPD	43 (43%)	57 (57%)
	25. Sensitive tuberculosis imaging follow-up	75 (75%)	25 (25%)

The relationships observed between the sociodemographic characteristics and the exposures of interest, i.e., type of university, geographic region of study, basic clinical semester (semesters 5-8), advanced clinical semester (semesters 9-12), exposure to PPD test, appropriate use of personal protection elements and experience in the care of TB patients, in relation to adequacy in the constructs are reported in Table 3.

Adequacy in the Clinic construct was related to the basic or advanced clinical semester in which the students were enrolled ($p = 0.014$), and adequacy in the Diagnosis construct was related to knowledge regarding the interpretation of PPD results ($p = 0.001$) and having had experience in the care of patients with TB ($p = 0.038$), (Table 3).

Adequacy in the treatment construct was related to the region where the students study ($p = 0.039$) and the perception of occupational risk of infection in care ($p = 0.024$). Adequacy in the Operational Management construct is related to the

geographic region where the students were studying (p = 0.003) and having performed a PPD test (p = 0.024). The weighted global adequacy was related to the geographical region of study (p = 0.002) (Table 3).

Table 3 The relationships between the sociodemographic characteristics and the exposures of interest in relation to adequacy in knowledge constructs

Variables	Epidemiology			Clinic			Diagnosis			Treatment			Operational management			Overall score		
	Not adequate	Adequate	p*	Not adequate	Adequate	p*	Not adequate	Adequate	p*	Not adequate	Adequate	p*	Not adequate	Adequate	p*	Not adequate	Adequate	p*
Sex: n																		
Male	8	26	0,246	6	28	0,747	3	31	0,618	6	28	0,131	19	15	0,398	18	16	0,879
Female	23	43		10	56		8	58		21	45		31	35		36	30	
Geographic region: n																		
Caribe	2	5	0,554	2	5	0,385	2	5	0,079	5	2	0,039	6	1	0,003	6	1	0,002
Centro Oriente	6	8		2	12		0	14		6	8		12	2		14	0	
Centro Sur	5	6		4	7		3	8		3	8		5	6		5	6	
Eje Cafetero	7	26		4	29		5	28		5	28		17	16		14	19	
Llanos	0	1		0	1		0	1		0	1		0	1		0	1	
Pacífico	11	23		4	30		1	33		8	26		10	24		15	19	
University type: n																		
Post	14	31	0,983	9	36	0,324	4	41	0,542	11	34	0,603	20	25	0,315	22	23	0,354
Private	17	38		7	48		7	48		16	39		30	25		32	23	
Clinical semester completed: n																		
Basic (semesters 5-8)	13	34	0,496	12	35	0,014	7	40	0,241	15	32	0,297	23	24	0,841	27	20	0,515
Advanced (semesters 9-13)	18	35		4	49		4	49		12	41		27	26		27	26	
Previous education regarding tuberculosis: n																		
Yes	31	65	0,171	16	80	0,373	10	86	0,361	26	70	0,927	48	48	1,000	52	44	0,870
No	0	4		0	4		1	3		1	3		2	2		2	2	
Performed a PPD test during training: n																		
Yes	12	27	0,968	5	34	0,488	2	37	0,133	8	31	0,243	14	25	0,024	18	21	0,208
No	19	42		11	50		9	52		19	42		36	25		36	25	
Knowledge regarding the interpretation of the PPD test: n																		

Yes	26	58	0,981	15	69	0,246	6	10	<0,001	23	61	0,844	41	43	0,585	42	42	0,066
No	5	11		1	15		5	79		4	12		9	7		12	4	
Experience in the care of patients with TB: n																		
Yes	22	50	0,878	11	61	0,752	5	67	0,038	16	56	0,084	33	39	0,181	36	36	0,198
No	9	19		5	23		6	22		11	17		17	11		18	10	
Correct use of personal protection elements: n																		
Yes	21	50	0,630	11	60	0,829	7	64	0,568	17	54	0,281	35	36	0,826	38	33	0,880
No	10	19		5	24		4	25		10	19		15	14		16	13	
Perception of the risk of infection during care: n																		
Yes	19	50	0,264	11	58	0,981	8	61	0,777	14	55	0,024	34	35	0,829	37	32	0,910
No	12	19		5	26		3	28		13	18		16	15		17	14	

Subsequently, the magnitude of association between sociodemographic characteristics and exposures of interest was evaluated based on adequacy in knowledge constructs and weighted global score (Table 4).

Compared with students from other regions, those from the Eje Cafetero region showed greater adequacy in the Epidemiology (OR: 3.71, 95% CI 1.61-8.55, p = 0.002), Clinic (OR: 7.25, 95% CI 2.54-20.62, p = 0.001), Diagnosis (OR: 5.6, 95% CI 2.16-14.5, p = 0.001) and Treatment (OR: 5.6, 95% CI 2.16-14.5, p = 0.001) constructs. Additionally, compared with students from other regions, students from the Centro Oriente region presented lower adequacy in the Treatment (OR: 0.23, 95% CI 0.57-0.98, p = 0.048) and Operative Management (OR: 0.17, 95% CI 0.03-0.91, p = 0.03) constructs.

Compared with students enrolled in basic clinical semesters, students enrolled in advanced clinical semesters presented greater adequacy in the Clinic construct (OR: 4.2, 95% CI 1.19-14.7, p = 0.01). Compared with students who did not perform a PPD test, those who reported having performed a PPD in their training presented greater adequacy in the Operative Management construct (OR: 2.57, 95% CI 1.92-6.05, p = 0.02). Students who reported knowledge in the interpretation of PPD test had greater adequacy in the Diagnostic construct (OR: 9.48, 95% CI 2.18-41.13, p = 0.002). Compared with students without experience in TB care, those who reported experience in the care of TB patients presented greater adequacy in the Diagnosis construct (OR: 3.65, 95% CI 0.98-13.6, p = 0.03). Compared with students who did not report perceiving an occupational risk of TB infection, students who reported perceiving this risk showed greater adequacy in the Treatment construct (OR: 2.83, 95% CI 1.09-7.35, p = 0.02).

Table 4 Factors related to adequacy in knowledge in the programmatic management of tuberculosis based on knowledge construct and weighted global score

Variable	Epidemiology	Clinic	Diagnosis	Treatment	Operational management	Overall score
	ORc CI (95%) p	ORc CI (95%) p	ORc CI (95%) p	ORc CI (95%) p	ORc CI (95%) p	ORc CI (95%) p
Sex						
Female	0,57 (0,22 - 1,48) 0,24	1,2 (0,39 - 3,66) 0,74	0,70 (0, 17 – 2,86) 0,61	0,45 (0,16 - 1,29) 0,13	1,43 (0,61 – 3,30) 0,40	0,93 (0,40 - 2,15) 0,87
University type						
Public	0,99 (0,42 - 2,33) 0,98	0,58 (0,19 - 1,73) 0,32	1,49 (0,40 – 5,51) 0,54	1,26 (0,51 – 3,12) 0,60	1,55 (0,67 – 3,33) 0,31	1,45 (0,65 - 3,23) 0,35
Geographic region						
Centro Sur	0,23 (0,75 – 1,37) 0,12	0,24 (0,04 – 1,21) 0,08	0,47 (0,09 - 2,43) 0,37	0,47 (0,09 – 2,43) 0,37	1,27 (0,32 - 5,01) 0,72	0,88 (0,22 – 3,49) 0,86
Centro Oriente	0,35 (0,09 - 1,38) 0,13	0,82 (0,13 - 5,13) 0,83	- -	0,23 (0,57 – 0,98) 0,048	0,17 (0,03 - 0,91) 0,03	- -
Pacífico	0,56 (0,18 - 1,69) 0,36	1,03 (0,23 – 4,53) 0,96	5,89 (0,64 – 53,4) 0,11	0,58 (0,16 – 2,00) 0,389	2,55 (0,93 – 6,96) 0,06	0,93 (0,35 – 2,45) 0,88
Eje Cafetero	3,71 (1,61 – 8,55) 0,002	7,25 (2,54 - 20,62) 0,001	5,6 (2,16 – 14,5) 0,001	5,6 (2,16 – 14,5) 0,001	0,94 (0,47 – 1,86) 0,86	1,35 (0,68 – 2,70) 0,38
Clinical semester completed						
Advanced Clinical (semesters 9-12)	0,74 (0,31 – 1,75) 0,49	4,2 (1,19 – 14,7) 0,01	2,14 (0,57 - 7,96) 0,24	1,60 (0,65 - 3,93) 0,29	0,92 (0,41 - 2,03) 0,84	1,30 (0,58 - 2,88) 0,51
General questionnaire						
Received education in tuberculosis	-	-	2,86 (0, 26 – 30,9) 0,36	0,89 (0,08 – 9,12) 0,92	1,00 (0,13 - 7,46) 1,00	0,84 (0,11 - 6,32) 0,87
Took a PPD test during training	1,01 (0,42 - 2,43) 0,96	1,49 (0,47 - 4,73) 0,49	3,20 (0,63 – 16,10) 0,13	1,75 (0,67 – 4,57) 0,24	2,57 (1,92 - 6,05) 0,02	1,68 (0,73 - 3,81) 0,21
Knowledge in the interpretation of PPD tests	1,01 (0,31 - 3,23) 0,98	0,30 (0,03 – 2,56) 0,24	9,48 (2,18 – 41,13) 0,002	0,88 (0,25 - 3,04) 0,84	1,34 (0,45 - 3,98) 0,58	3,0 (0,87 - 10,33) 0,06
Experience in the care of	1,07 (0,41 - 2,76) 0,87	1,20 (0,37 – 3,87) 0,75	3,65 (0,98 – 13,6) 0,03	2,26 (0,86 - 5,91) 0,08	1,82 (0,74 - 4,49) 0,18	1,80 (0,72 - 4,48) 0,20

patients with TB						
Correct use of PPE	1,25 (0,49 - 3,.16) 0,63	1,13 (0,35 - 3,64) 0,82	1,46 (0,39 - 5,48) 0,57	1,67 (0,64 - 4,32) 0,28	1,10 (0,46 - 2,62) 0,82	1,06 (0,44 - 2,55) 0,88
Perception of the risk of TB infection	0,61 (0,67 - 4,10) 0,26	1,01 (0,31 - 3,23) 0,98	0,81 (0,19 – 3,33) 0,77	2,83 (1,09 – 7,35) 0,02	1,09 (0,46 - 2,57) 0,82	1,05 (0,44 - 2,47) 0,91

DISCUSSION

The knowledge, practices and attitudes of the medical students in Colombia evaluated in this study are low and differ by the region in which they study. PPD during clinical training suggests exposure that favors learning about TB.

This study included a cross-sectional analysis of the level of knowledge, practices and attitudes about TB in Colombia by medical students who were participating in a clinical rotation and the relationship with exposure variables such as region of study, clinical semester attended, previous TB education, experience with TB screening (with the PPD test), clinical experience caring for TB patients, correct use of personal protection elements and perception of the risk of TB infection.

Previously, Wilches[12] found that students from a health school in Southwest Colombia had insufficient knowledge about the prevention, diagnosis and treatment of TB and that these same students had a high prevalence of latent TB infection. However, this study explored exposures that were related to greater adequacy in programmatic knowledge about TB and what elements of the TB education strategy favor the learning process.

Student in the region with the greatest disease burden, Eje Cafetero, in which students carry out their clinical rotations in different health care centers, could have a greater opportunity to care for patients with TB, an observation that is supported by findings in the literature. Time and number of patients are related to the level of knowledge about TB of final-year medical students[17,18].

Additionally, in this study, students who had personal experience with TB screening (PPD test) and claimed to have knowledge in the interpretation of PPD screening tests presented greater adequacy in diagnostic knowledge about TB, a finding similar to that for students in me[19,20].

The execution of this study was limited due to the quarantine measures for COVID-19. For this reason, the method for applying the survey was changed from in-person to virtual, using a short questionnaire (36 questions) focused on the programmatic management of TB. Even with a smaller sample, it was possible to observe associations previously documented in the literature, and a standard effect (programmatic knowledge of TB) was expected.

Students who did not respond may have had limited time because of work or little interest in the objectives of the study; importantly, if the lack of knowledge contributed to lower participation, the results may represent better-informed students.

Adjustments were made in the statistical analyses that relate knowledge to regions by means of logistic regression, in which the Eje Cafetero was the reference region.

The surveys were sent proportionally to the students of the different regions; however, this did not guarantee representativeness because participation was voluntary and asynchronous through a virtual platform, and due to the anonymous nature of the survey, we do not have information from students who did not respond.

Systematic learning has been described with the help of clinical cases in highly complex clinical settings; however, this experience is biased, because TB treatment includes clinical and operative follow-up of at least 6 months per patient. It is possible that a gap exists between clinical skills as taught and clinical practice, which requires operational management in primary care where medical care for TB is developed.

The lack of experience in the follow-up of patients with TB in low complexity health care constitutes a premature closure in the learning process for medical students, leading to insufficient knowledge[21]. It is important to develop students' knowledge through experience in the programmatic management of TB.

For universities, the educational strategy used is key to impacting the operational management skills of graduates. A report released by experts of the Pan American Health Organization (PAHO) concludes that the acquisition of skills for operational management is not achieved through the teaching of regulations[22].

In other studies, there is evidence that learning roles in value-added clinical systems enhance learning by students when they participate as authentic members of health care teams because students provide an active contribution in the care of patients and such systems contribute to the development of interprofessional skills[23,24].

In Latin America, the ministries of health show deficiencies in operational research; for example, the ministry of India in collaboration with universities evaluated the implementation of the DOT (Directly Observed Treatment) strategy in India in 1990, which allowed curing 85% of the cases detected and for which mandatory rotations in TB care services were proposed[25].

CONCLUSION

The results suggest that knowledge of tuberculosis is deficient among medical students in Colombia. Teaching activities should be considered in primary care settings where students participate in the programmatic management of TB. Additionally, the National Network for Knowledge Management, Research and Innovation in Tuberculosis in Colombia and universities should agree on the strategic lines of work to strengthen the care of patients with TB in all regions.

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