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**Article of scientific and technological research**

# Knowledge, attitudes and practices about tuberculosis in health workers in a health institution in Bogotá, Colombia

# Conocimientos, actitudes y prácticas sobre tuberculosis en trabajadores de la salud en una institución de salud de Bogotá, Colombia

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**ABSTRACT**

**Introduction:** Despite scientific advances, tuberculosis remains on the global and national epidemiological stage. **Objective:** To describe the knowledge, attitudes and practices about tuberculosis in health workers before and after an educational intervention in a health institution in Bogotá. **Method**: A quasi-experimental study was developed with a control group and an experimental group with measurement before and after an educational intervention between October 2021 and March 2022. A previously validated instrument was used to measure knowledge, attitudes and practices of tuberculosis. **Results**: This study demonstrated, post intervention, adequate knowledge on topics such as: disease transmission, treatment and isolation measures. At the level of attitudes, a false perception of safety against the disease on the part of the health worker was evident. Finally, some practices after the intervention improved in terms of the search for respiratory symptoms, separation of patients with cough and use of personal protection elements. **Conclusions:** Educational interventions in health workers are essential to improve knowledge, attitudes and practices about tuberculosis, for the benefit of workers and patients, contributing to reducing the transmission of the disease.

**Keywords:** Knowledge; Attitudes and Practice in Health; Health Education; Health personnel; Public health; Tuberculosis

**RESUMEN**

**Introducción:** a pesar de los avances científicos la tuberculosis se mantiene en el escenario epidemiológico mundial y nacional. **Objetivo:** describir los conocimientos, actitudes y prácticas sobre tuberculosis en trabajadores de la salud antes y después de una intervención educativa en una institución de salud en Bogotá. **Método:** se desarrolló un estudio cuasiexperimental con grupo control y grupo experimental con medición antes y después de una intervención educativa entre octubre del 2021 y marzo del 2022. Se utilizó un instrumento previamente validado para medir los conocimientos, actitudes y prácticas de la tuberculosis. **Resultados:** este estudio demostró post intervención, conocimientos adecuados en temáticas como: transmisión de la enfermedad, tratamiento y medidas de aislamiento. A nivel de las actitudes, se evidenció una falsa percepción de seguridad frente a la enfermedad por parte del trabajador de la salud. Finalmente, algunas prácticas posteriores a la intervención mejoraron en términos

**Palabras clave:** conocimientos, actitudes y práctica en salud; educación en salud; personal de salud; salud pública; tuberculosis

de la búsqueda de sintomáticos respiratorios, separación de pacientes con tos y uso de elementos de protección personal. **Conclusiones:** las intervenciones educativas en trabajadores de la salud son fundamentales para mejorar los conocimientos, actitudes y prácticas sobre tuberculosis, en beneficio de los trabajadores y los pacientes, contribuyendo a disminuir la transmisión de la enfermedad.

## INTRODUCTION

The emergence of new drugs and diagnostic advances for tuberculosis control is recognized; however, the disease persists in the global and national epidemiological profile. The World Health Organization (WHO) estimated in 2021 that 10.6 million people had fallen ill, of whom 1.6 million died[1]. Health workers continue to be susceptible to tuberculosis; in 2019, 22,314 were reported worldwide, a figure that has been related to underreporting[1].

Tuberculosis in health workers in Colombia is a reality; for example, in 2019, 233 cases were reported, of which nursing assistants, medical personnel, and nurses contributed 76%, and deaths of health workers for tuberculosis[2].

Taking the above into account, health workers are vulnerable to tuberculosis, reporting a risk three times greater than the general population of contracting tuberculosis[3]. The risk factors that influence and increase vulnerability to tuberculosis depend on the intra-work, extra-work, and individual working conditions of each worker[4]. Some factors most related to transmission are inadequate implementation of tuberculosis infection control measures, exposure time, and work area[5]. They are added to job instability, wage gaps, underemployment, and physical and mental overload; finally, at a personal level, age, gender, occupation, health status and knowledge, attitudes, and practices influence[6].

Likewise, the knowledge, attitudes, and practices of health workers regarding tuberculosis have been reported as low and intermediate in previously developed research[7], as demonstrated in a Colombian study that found a low level of knowledge in the programmatic management of tuberculosis. tuberculosis[8]. This limited knowledge, added to stigma, negative beliefs, and inadequate health practices, has been directly related to the poor implementation of infection control measures, which contributes to exposure and transmission of the disease to health workers[9].

In an intervention evaluative study previously carried out in a hospital institution in the city of Bogotá, where 216 health workers participated, an increase in knowledge and practices of tuberculosis infection control measures was verified in topics such as the PPD (tuberculin skin test), the capture of respiratory symptoms, natural cross ventilation, mechanical ventilation, high-efficiency N95 mask, all showed significance ($p<0.05$)[10].

In this sense, low knowledge about tuberculosis, added to the lack of induction processes and limited financing of tuberculosis programs, leads to the perpetuation of this problem in work settings[11,12].

This research developed a quasi-experimental study to describe the knowledge, attitudes, and practices about tuberculosis of health workers before and after an educational intervention in a health institution in the city of Bogotá.

## METHOD

### Kind of investigation

A quasi-experimental study with an intervention group and control group, with pre- and post-test measurement after an educational intervention, was developed between October 2021 and March 2022. The dependent variables were measured with the instrument of knowledge, attitudes, and practices in tuberculosis, previously validated by the Health and Care of the Collectives research group to health workers from a health institution in Bogotá, Colombia.

### Participants

To estimate the sample size, in the evaluation of the hypothesis of increasing average knowledge of tuberculosis due to the educational strategy intervention, the previous study in hospital workers was taken as a basis, with an average knowledge of tuberculosis of 66.4±26.3%, expecting a minimum increase effect of 10% on average for the educational intervention, with a reliability of 95% and a power of

90%, with a 1:1 ratio, the selected sample size was 171:171.

The inclusion criteria for the participants were being a health worker on staff or providing services, having access to the internet and a smartphone or computer, and accepting voluntary participation in a tertiary care health institution in Bogotá. On the other hand, the exclusion criteria were health workers who managed the tuberculosis program at the institution, had received training during the time of the study, and had suffered from tuberculosis.

### Instruments

Sociodemographic data were collected, and the Knowledge, Attitudes, and Practices Instrument on tuberculosis for health workers was used. The Instrument has three dimensions: knowledge, attitudes, and practices, and 40 items. The content validation achieved a Global Content Validity Index of 0.96. Face validation demonstrated the comprehensibility of the items at 84% (n = 37).

After selecting the sample and inviting the participants, data collection was carried out. The research team also had two previously trained research assistants for the collection and tabulation of information in the fieldwork phase.

### Procedure

A virtual educational intervention was carried out, with the use of Information and Communication Technology (ICT) tools based on the Moodle platform of the National University of Colombia, for the creation of the virtual course; it began with a review of the scientific literature analysis and selection of the course content, then the content validation of the virtual environment (11 Virtual Learning Objects) was carried out with thematic, programmatic and methodological experts. After the previous step, the contents of the themes were diagrammed on the Moodle platform, where functionality tests were carried out before their final publication.

The virtual educational intervention had an average duration of 40 hours, was self-directed by the health worker, and comprised three modules (general information about tuberculosis, infection control, and programmatic aspects). The maximum time to complete the course was four weeks, with a pretest and a post-test.

A descriptive analysis of qualitative variables was carried out with absolute frequencies and percentages, and in the quantitative ones with measures of central tendency and dispersion, normality was previously evaluated with the Kolmogorov-Smirnov and Shapiro Wilk test; when normality was present, the average and the standard deviation or median and range in distributions other than normal.

In comparing before (baseline) between the intervention group and the control group in the dichotomous qualitative variables, the Pearson Chi-square test of differences in proportions or the Fisher exact test (2x2) or exact likelihood ratio was used. (expected values<5) and in the ordinal qualitative variables (Likert scale), the two-tailed Mann Whitney-Wilcoxon test. In the post-intervention evaluation, the Fisher exact test (2x2) or one-tailed likelihood ratio (expected values<5) was used for the dichotomous qualitative variables, and in the ordinal qualitative variables (Likert scale), the one-tailed Mann Whitney-Wilcoxon test.

### Statement on ethical aspects

**00**This study considered Resolution 8430 of 1993 of the Colombian Ministry of Health, where research is classified as having minimal risk due to the project's scope. In addition, international ethical guidelines for research on human subjects established in the Nuremberg Code and the Declaration of Helsinki were followed. In that sense, the ethical principles of beneficence, non-maleficence, justice, autonomy, and truthfulness were respected by each participant. The research project was approved by the ethics committee of the Faculty of Nursing of the National University of Colombia and the ethics committee of the District Health Secretariat. Finally, all participants voluntarily signed the informed consent before entering the study.

## RESULTS

### Sociodemographic characteristics

Three-hundred thirty-one health workers participated in this study: 171 in the intervention gro up and 170 in the control group. The sociodemographic

characteristics showed a young adult population with an average age of 38.4±11.2 years (med=38.0 years), mainly women (79.8%), single (55.7%), and with a technical educational level (46.3%). The most frequent occupations were nursing assistants (45.2%), nurses (22.6%), and doctors (13.8%); it is highlighted that more than 59.2% of the workers had contracts in order of provision of services.

**Knowledge about tuberculosis in health workers**

Concerning knowledge about tuberculosis, after the educational intervention it was found that regarding the causal agent of tuberculosis, 97.7% of correct answers were obtained, and 87.7% of valid answers were obtained for the question of whether Mycobacterium *tuberculosis* is sensitive to heat and sunlight; About whether the patient should use the surgical mask in the first days of treatment, 75.4% correct answers were obtained; The other knowledge items, the comparison with the control group, and the significance are presented below (Table 1).

In the general scale of knowledge about TB, a significant difference was found, with the intervention group being higher (86.2±8.2%, mean=86.0) than in the control group (76.6±10.8 mean=76.4) (p=0.001, Mann Whitney-Wilcoxon Test). In 28 of the 43 knowledge items, a significant increase was found in the intervention group compared to the control group. In the differences on the TB knowledge scale (post-pre), a significant difference was found, greater in the intervention group (5.7±8.5, med=4.7, p<0.001).

**Attitudes about tuberculosis**

The evaluation of attitudes after the intervention identified that health workers seldom feel at risk of becoming infected with tuberculosis 67.3%; they also state that they have not felt afraid of getting sick from tuberculosis 79.5%. On the other hand, they report that if they got sick with tuberculosis, they would always inform coworkers 87.7%, family members 91.8%, and friends 79.5%. Comparisons between intervention and control groups and statistical significance are presented below (Table 2).

**Table 1.** Knowledge about tuberculosis, after the intervention, intervention group, and control group, in health workers at a hospital in Bogotá.

| Variable | | Groups Intervention Count | %N | Control Count | %N | Next p |
|---|---|---|---|---|---|---|
| Is the causative agent of tuberculosis a bacterium? | Correct | 167 | 97.7 | 150 | 88.2 | <0.001* |
| | Incorrect | 4 | 23 | 20 | 11.8 | |
| Is *Mycobacterium tuberculosis* sensitive to heat and sunlight? | Correct | 150 | 87.7 | 91 | 53.5 | <0.001* |
| | Incorrect | 21 | 12.3 | 79 | 46.5 | |
| Do patients hospitalized with pulmonary tuberculosis during the first weeks of treatment require aerosol isolation? | Correct | 168 | 98.2 | 164 | 96.5 | 0.248* |
| | Incorrect | 3 | 1.8 | 6 | 3.5 | |
| Should a patient with pulmonary tuberculosis use the N95 respirator in the first days of their treatment? | Correct | 109 | 63.7 | 50 | 29.4 | <0.001* |
| | Incorrect | 62 | 36.3 | 120 | 70.6 | |
| Should patients with pulmonary tuberculosis use the surgical mask in the first days of their treatment? | Correct | 129 | 75.4 | 91 | 53.5 | <0.001* |
| | Incorrect | 42 | 24.6 | 79 | 46.5 | |
| Does the surgical mask protect a health worker from pulmonary tuberculosis droplets? | Correct | 142 | 83.0 | 114 | 67.1 | <0.001* |
| | Incorrect | 29 | 17.0 | 56 | 32.9 | |

*One-tailed exact tests.

**Table 2.** Attitudes about tuberculosis in health workers at a hospital in Bogotá.

| Variable | | Groups | | | | |
|---|---|---|---|---|---|---|
| | | Intervention | | Control | | |
| | | Count | %N | Count | %N | Next p |
| Do you feel at risk of becoming infected with tuberculosis? | Never | 0 | 0.0 | 21 | 12.4 | <0.001 |
| | Hardly ever | 115 | 67.3 | 22 | 12.9 | |
| | Occasionally | 0 | 0.0 | 69 | 40.6 | |
| | Almost always | 28 | 16.4 | 32 | 18.8 | |
| | Always | 28 | 16.4 | 26 | 15.3 | |
| Have you been afraid of getting sick with tuberculosis? | Never | 0 | 0.0 | 47 | 27.6 | 0.233 |
| | Hardly ever | 136 | 79.5 | 3.4 | 20.0 | |
| | Occasionally | 0 | 0.0 | 47 | 27.6 | |
| | Almost always | 16 | 9.4 | 19 | 11.2 | |
| | Always | 19 | 11.1 | 23 | 13.5 | |
| If you get sick from tuberculosis, would you inform your coworkers about your illness? | Never | 0 | 0.0 | 3 | 1.8 | 0.172 |
| | Hardly ever | 8 | 4.7 | 1 | 0.6 | |
| | Occasionally | 0 | 0.0 | 3 | 1.8 | |
| | Almost always | 13 | 7.6 | 8 | 4.7 | |
| | Always | 150 | 87.7 | 155 | 91.2 | |
| If you get sick with tuberculosis, would you inform your family of your illness? | Never | 0 | 0.0 | 1 | 0.6 | 0.046 |
| | Hardly ever | 6 | 3.5 | 0 | 0.0 | |
| | Occasionally | 0 | 0.0 | 4 | 2.4 | |
| | Almost always | 8 | 4.7 | 1 | 0.6 | |
| | Always | 157 | 91.8 | 164 | 96.5 | |
| If you got sick with tuberculosis, would you tell your friends about your illness? | Never | 0 | 0.0 | 6 | 3.5 | 0.415 |
| | Hardly ever | 21 | 12.3 | 5 | 2.9 | |
| | Occasionally | 0 | 0.0 | 12 | 7.1 | |
| | Almost always | 14 | 8.2 | 14 | 8.2 | |
| | Always | 136 | 79.5 | 133 | 78.2 | |
| If a coworker was diagnosed with active tuberculosis, would you support him? | Never | 0 | 0.0 | 0 | 0.0 | 0.359 |
| | Hardly ever | 2 | 1.2 | 1 | 0.6 | |
| | Occasionally | 0 | 0.0 | 7 | 4.1 | |
| | Almost always | 15 | 8.8 | 10 | 5.9 | |
| | Always | 154 | 90.1 | 152 | 89.4 | |
| If a coworker is diagnosed with latent tuberculosis infection, would you avoid contact with him? | Never | 0 | 0.0 | 78 | 45.9 | <0.001 |
| | Hardly ever | 136 | 79.5 | 24 | 14.1 | |
| | Occasionally | 0 | 0.0 | 33 | 19.4 | |
| | Almost always | 8 | 4.7 | 18 | 10.6 | |
| | Always | 27 | 15.8 | 17 | 10.0 | |

**Practices on tuberculosis**

Regarding the practices on tuberculosis in the intervention group, it was found that only 31.6% always actively searched for respiratory symptoms. Additionally, only 22.8% of participants requested serial sputum smear microscopy for a patient with respiratory symptoms. On the other hand, regarding separating patients with coughs from other users, this practice is only always carried out by 40.9% of workers. With the use of the N95 respirator when in contact with a patient newly diagnosed with tuberculosis, 93.6% said they always do it, and when offering the surgical mask to the patient newly diagnosed with tuberculosis, 60.8% mentioned doing this permanently. Comparisons with the control group and statistical significance are presented below (Table 3).

Table 3. Practices on tuberculosis of health workers in a hospital.

| Variable | | Groups | | | | |
|---|---|---|---|---|---|---|
| | | Intervention | | Control | | |
| | | Count | %N | Count | %N | Next p |
| Do you actively search for respiratory symptoms in your patients? | Never | 11 | 6.4 | 12 | 7.1 | 0.058 |
| | Hardly ever | 12 | 7.0 | 15 | 8.8 | |
| | Occasionally | 42 | 24.6 | 35 | 20.6 | |
| | Almost always | 52 | 30.4 | 46 | 27.1 | |
| | Always | 54 | 31.6 | 62 | 36.5 | |
| Do you request serial sputum smear microscopy for a symptomatic respiratory patient? | Never | 64 | 37.4 | 62 | 36.5 | <0.001 |
| | Hardly ever | 13 | 7.6 | 9 | 5.3 | |
| | Occasionally | 31 | 18.1 | 28 | 16.5 | |
| | Almost always | 24 | 14.0 | 28 | 16.5 | |
| | Always | 39 | 22.8 | 43 | 25.3 | |
| Do you separate a patient with a permanent cough from other users in the health institution? | Never | 9 | 5.3 | 11 | 6.5 | 0.002 |
| | Hardly ever | 17 | 9.9 | 12 | 7.1 | |
| | Occasionally | 30 | 17.5 | 28 | 16.5 | |
| | Almost always | 45 | 26.3 | 43 | 25.3 | |
| | Always | 70 | 40.9 | 76 | 44.7 | |
| Do you use the N95 respirator when you are in contact with a patient with newly diagnosed pulmonary tuberculosis? | Never | 1 | 0.6 | 5 | 2.9 | 0.034 |
| | Hardly ever | 0 | 0.0 | 3 | 1.8 | |
| | Occasionally | 1 | 0.6 | 4 | 2.4 | |
| | Almost always | 9 | 5.3 | 2 | 1.2 | |
| | Always | 160 | 93.6 | 156 | 91.8 | |
| Do you offer a surgical mask to a patient with pulmonary tuberculosis during the start of treatment at the health institution? | Never | 38 | 22.2 | 47 | 27.6 | <0.001 |
| | Hardly ever | 7 | 4.1 | 9 | 5.3 | |
| | Occasionally | 8 | 4.7 | 10 | 5.9 | |
| | Almost always | 14 | 8.2 | 8 | 4.7 | |
| | Always | 104 | 60.8 | 96 | 56.5 | |

## DISCUSSION

The results of this study demonstrated a strengthening of knowledge after the educational intervention on topics such as disease transmission, treatment, and isolation measures. However, knowledge related to personal protection elements still needs to be improved. At the level of attitudes, a low perception of risk towards the disease was found; in addition, there was manifestation of support networks at work, family, and friends. Finally, the practices referred to were correct regarding the search for respiratory symptoms, separation of patients with cough, and use of personal protection elements.

These results are comparable with studies that have measured the knowledge, attitudes, and practices of health workers in different countries. In terms of the first dimension, Vigenschow *et al*[13] demonstrated that there was generally intermediate (40.8%), good (28.2%), and poor (21.4%) knowledge among the interviewed personnel. Another investigation in Afghanistan identified good knowledge in 87.7% of its participating workers and positive attitudes in 96.7%[14].

However, research has been found where knowledge is low, mainly in countries with a high burden of the disease[15-18]. Some of the gaps in knowledge are in the etiology of the disease, transmission and prevention of contagion, risk factors, signs and symptoms, and childhood tuberculosis[15,18,19].

On the other hand, the influencing factors are educational level, work experience, type of health facility, previous training in tuberculosis, and having a family member with tuberculosis[13,16,20].

Considering the low knowledge about tuberculosis among health workers, research has designed and implemented virtual (synchronous and asynchronous) and in-person educational interventions that have obtained similar results to the current study. Wang *et al*[20] designed a quasi-experimental study with a virtual educational intervention compared to face-to-face education in China. Asynchronous learning significantly improved the knowledge of medical staff compared to in-person education. This study associated the high-quality knowledge acquired with positive behavioral changes in workers[21]. In the present study, the results related to the etiology and transmission mechanism improved after the intervention.

Similarly, Ancy *et al*[22] demonstrated the effectiveness of a virtual educational intervention in increasing knowledge about tuberculosis in health personnel using WhatsApp as a tool. The topics with the best scores after the intervention were signs and symptoms, resistant tuberculosis, diagnosis, and treatment. This study differs from the current research with the educational strategy used, which was a social network; however, the results demonstrated the effectiveness of virtual learning.

The benefits of virtual education are the cost-effectiveness of the programs, better and more up-to-date content, and flexible work schedules[23,24]. On the other hand, some limitations compared to virtual education are dissatisfaction with learning due to lack of physical interaction with teachers, insufficient hardware and software, little organizational support, lack of incentives for continuing education, limited access to the internet, limited time, and insufficient technological literacy[23,25].

In the same way, it was identified that the populations that prefer virtual education are women and people under 40 years of age. Some modalities participants prefer in virtual intervention studies are forums, case studies, and self-paced learning[25].

On the other hand, at the level of attitudes, the lack of risk perception identified in this study is a problem due to the false perception of safety that some health workers express. This result differs from other investigations where workers expressed fear of contracting the disease, and because of this, they incurred stigmatizing attitudes[13,16,17,19]. This feeling was related to the severity of active tuberculosis, the transmission of the disease to close relatives, and the prolonged treatment time and its adverse effects[13]. Concerning the attitudes in the present study, most workers reported, for example, in the case of a coworker being diagnosed with active tuberculosis, the majority responded that they would support it.

Some of the stigmatizing attitudes towards patients with tuberculosis are the low compassion and desire to help people with tuberculosis[15,16].

In the present study, appropriate practices, such as the separation of patients with cough, the search for respiratory symptoms, and the correct use of PPE by patients and workers, as in this research, have been reported in other workers worldwide. For example, a cross-sectional study with 93 health workers states that 48.5% of the participants separate symptomatic respiratory patients, 54.4% know how to use a respirator when caring for a patient with tuberculosis, and 53.4% offer surgical masks to infectious patients[13]. Along the same lines, another investigation reported that 76.5% of workers always open the windows of the waiting room for patients with cough, and 74.5% continually educate about the ethics of cough[20].

The scientific literature makes evident a gap in educational interventions that affect attitudes and practices. However, in patients with tuberculosis, attitudes, and practices have been measured after the development of educational programs, demonstrating that health education can significantly increase positive attitudes, reducing stigma and negative feelings about the disease in patients. and family members[26].

In terms of practices, the increase in knowledge is related to developing preventive and control practices against tuberculosis, with a high level of awareness regarding the transmission of the disease, adherence to treatment, and control measures of infections in the home[26]. In the workers, it was evident that good knowledge about tuberculosis is directly proportional to the increase in the quality of patient care, decrease in nosocomial transmission, adequate implementation of personal control measures, and less stigma towards people with tuberculosis[13,16,17].

In the results obtained in the research, adequate practices were related to adequate knowledge on the part of health workers about the disease; however, it

was found that knowledge related to the adequate use of personal protection elements such as high-efficiency respirators, the use of surgical masks; They require strengthening with other types of education methodologies, since erroneous practices persist, which increase the risk of transmission of *Mycobacterium tuberculosis* to health workers.

Taking into account the above, health professionals have a relevant role in society and health systems since they help promote health, prevent disease, and accompany the processes of the life cycle in different environments: individual, family, and community[27]. In this sense, the activities carried out by health personnel must have a high social value, accompanied by decent working conditions that allow the task to be carried out adequately, thus improving the quality of services, patient care, and worker self-care[28].

Thus, the United States Centers for Disease Control and Prevention, like the WHO, recommends training and education on tuberculosis at least once a year[29,30]. The benefits of continuing education for staff have been demonstrated in outcomes such as timely diagnosis, successful treatment, appropriately implemented infection control measures, and improved patient care[31].

It is essential to highlight that education must be continuous and permanent; some studies have shown that the knowledge of trained workers about tuberculosis increases immediately after the intervention but decreases progressively over time[32]. In this sense, knowledge one year after training can decrease by up to 50% compared to the post-test measurement immediately afterward, which requires institutions to monitor and update constantly. On the contrary, some factors that favor the maintenance of knowledge are years of work experience and attendance at training courses at least every six months[32].

Among the strengths of the study, it is found that the evaluation of knowledge, attitudes, and practices in tuberculosis will guide future research on the subject of study, as it could be observed that inadequate knowledge regarding the disease persists, as well as attitudes, and erroneous practices, which may be contributing to inadequate control of the disease.

## LIMITATIONS

The limitations found in the research, on the one hand, was the lack of knowledge about access to the ICT tool, where some health workers stated that they did not know access to virtual platforms such as Moodle; on the other hand, some workers expressed difficulties in the internet connection to develop the virtual course, and finally, as it developed during the COVID-19 pandemic, some workers mentioned having work overload and little time to access the virtual platform. Likewise, some practices did not improve with the intervention, which invites us to review additional strategies in the interventions and logically for future projects to make methodological adjustments about the practices since, according to several authors, modifying them requires more time and structured actions.

The social importance of health workers is highlighted; therefore, it is necessary to continue with the design and execution of educational interventions for these workers based on multimodal strategies that can contribute to strengthening knowledge, attitudes, and appropriate practices.

## CONCLUSIONS

In conclusion, a significant increase in knowledge was found in the intervention group compared to the control group in a large proportion of items evaluated. Adequate knowledge can contribute to positive attitudes and correct practices. On the other hand, it is crucial to implement educational strategies and multimodal intervention programs for health workers in tuberculosis since trained workers will give better health results by promoting self-care and care for people affected by this disease and their families.

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## STATEMENT ON CONFLICT OF INTEREST

The authors declare no conflict of interest in the article presented.

## CONTRIBUTION OF THE AUTHORS

**The First author participated in** the research direction and supported the analysis, review, and editing of the article.
**The second, third, and fourth authors** were co-investigators, supported in the analysis, reviewed, and editing of the article.

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