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Knowledge, Attitude, and Practices of Healthcare Workers Towards Tuberculosis, Multidrug-Resistant Tuberculosis, and Extensively Drug-Resistant Tuberculosis

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Abstract: Tuberculosis (TB) is an infectious disease caused by bacteria that primarily target the lungs. The transmission of this disease occurs through the air in the form of droplet nuclei. Unfortunately, there has been an emergence of resistance to strains of such infections, such as multidrug- as well as extensively drug-resistant strains. Healthcare workers (HCWs) are particularly vulnerable to contracting TB due to their direct contact with patients. This study aims to evaluate the knowledge, attitude, and practices among Lebanese healthcare workers towards TB and its resistant forms, particularly multidrug-resistant TB (MDR-TB) and extensively drug-resistant TB (XDR-TB). This study is a cross-sectional, descriptive, questionnaire-based research study that was conducted on HCWs in Lebanon. A total of 517 HCWs were included in this study. The findings displayed that 48.52% of HCWs had good knowledge of TB and MDR-TB/XDR-TB, 49.52% had average knowledge, and 2.13% had bad knowledge. Moreover, only 16.25% had a good attitude, 71.92% had an average attitude, and 11.8% had a bad attitude. Furthermore, only 14.7% had good practices, 54.74% had average practices, and 30.56% had bad practices. Having a history of testing for TB was found to be related to increased attitude. Also, the history of having TB-infected family members was found to be linked to both increased attitude and practice scores. Moreover, this study highlights the idea that high knowledge scores do not mean high attitude or high practices scores. On the same note, acceptable attitude scores do not inflict acceptable practice scores. The findings of this study showed that there is an overall good knowledge regarding TB, MDR-TB, and XDR-TB, average attitude, and average-to-bad practices. Gaps are seen in all sectors, even knowledge, especially with matters related to the diagnosis of MDR-TB/XDR-TB and its treatment duration. Also, the attitude section revealed a gap in the understanding of the modes of transmission of such an infection.

Keywords: attitude; knowledge; MDR-TB; practice; TB; TB infection control; XDR-TB

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1. Introduction

For generations, tuberculosis (TB) has been a global health concern and continues to cause epidemics across the globe [1]. TB is a bacterial infection that can be transmitted through the air. It is caused by the bacterium *Mycobacterium tuberculosis* (*M. tuberculosis*) and can affect various parts of the body, with the lungs being the most affected. When individuals with pulmonary or laryngeal TB cough, sneeze, or talk, the bacterium is released into the air as droplet nuclei. These droplet nuclei can be inhaled by others,

passing through the mouth or nasal cavities, the upper respiratory tract, and the bronchi, eventually, reaching the alveoli of the lungs [2]. There are two distinct forms of TB: latent TB infection (LTBI), which typically has no symptoms, and active TB disease (ATBD), which presents with noticeable symptoms [3]. TB remains a major threat to adults in the prime of their lives, particularly those who are economically active and individuals living with human immunodeficiency virus (HIV). Even if someone successfully recovers from symptomatic TB, they may still experience long-term consequences that greatly diminish their overall quality of life [4].

The Global Tuberculosis Report 2020, published by the World Health Organization (WHO), reveals that TB ranks as the ninth most common cause of death globally and stands as the primary cause of death caused by a single infectious agent, surpassing HIV [5]. However, according to the Global Tuberculosis Report 2023, TB ranked as the second leading cause of death worldwide from a single infectious agent, after coronavirus disease 2019 (COVID-19), and led to almost twice as many deaths as HIV [6]. In the year 2016, approximately 1.3 million deaths due to TB were recorded among individuals who were not infected with HIV. Additionally, there were 374,000 deaths among individuals who were HIV-positive. It is estimated that around 10.4 million people fell ill with TB in 2016, with adults accounting for 90% of the cases, males comprising 65% of the cases, and individuals living with HIV making up 10% of the cases [3]. Then, in the year 2017, the global incidence of TB witnessed a staggering 10 million new cases, leading to a significant toll of 1.3 million fatalities [7]. Moreover, in 2022, the WHO received reports of over 10.6 million new TB cases and 1.3 million fatalities [5].

The emergence of drug-resistant TB (DR-TB) and multidrug-resistant TB (MDR-TB), as well as extensively drug-resistant TB (XDR-TB), poses a significant global menace and a major inconvenience in TB control [1,6]. MDR-TB strains are defined as strains resistant to at least isoniazid and rifampicin, which are the two most powerful first-line drugs for tuberculosis. XDR-TB strains, on the other hand, are drug-resistant strains that are additionally resistant to a fluoroquinolone and at least one of the three second-line injectable drugs (kanamycin, amikacin, and capreomycin) [8]. Annually, it is estimated that almost 500,000 TB patients worldwide are infected with MDR-TB strains, with only a quarter of them receiving sufficient treatment. In 2016, there were approximately 490,000 new cases of MDR-TB and around 240,000 deaths caused by this disease-causing pathogen. Most of these cases, over 90%, were reported in thirty countries categorized as low- or middle-income nations [7].

In Lebanon, TB is classified as one of the communicable, notifiable diseases included in the Ministry of Public Health's list. Despite the relatively low occurrence of this disease in Lebanon (16 cases per 100,000 population), it is crucial to acknowledge and tackle this infection. Since 2006, there has been a steady increase in the number of TB cases in Lebanon, resulting in higher mortality rates, particularly among HIV-seropositive individuals. In 2016 alone, a total of 860 individuals in Lebanon were diagnosed with TB. Lebanon is home to a diverse population, including refugees from both Syria and Palestine and workers from countries, such as Bangladesh, Pakistan, Philippines, the Russian Federation, Vietnam, Ethiopia, India, and other nations. These countries are among the top 30 worldwide with the highest incidences of MDR-TB [1]. Therefore, it is imperative for healthcare workers (HCWs) in Lebanon to possess knowledge regarding different M. tuberculosis strains and the appropriate measures to combat such infections, as they play a vital role in the fight against TB. Additionally, their frequent exposure to infected patients with this bacterium renders them highly susceptible to TB infection [7].

While the prevention of occupational TB and the implementation of infection control measures in healthcare settings are crucial, there are instances where adhering to these mea-

sures becomes more difficult. This is especially true in low- and middle-income countries or resource-constrained settings. There is a lack of evidence concerning HCWs' knowledge, attitude, and practices regarding TB, MDR-TB, and XDR-TB in Lebanon. As a first-of-kind, this study aims to assess the knowledge, attitude, and practices of HCWs working in Lebanese healthcare institutions towards the mentioned strains of *M. tuberculosis*.

2. Materials and Methods

2.1. Research Design

This study is a prospective descriptive cross-sectional study with a self-administered questionnaire conducted for 3 full months from February to April 2024 among HCWs in Lebanon.

2.2. Setting

The study was conducted across Lebanon. It included participants from all Lebanese regions.

2.3. Target and Study Population

A sample of 529 HCWs from different Lebanese regions participated in the study in a voluntary manner. The research team did not, in any form, provide allurements to participants in order to fill out the questionnaire. All important questions were marked as mandatory in order to prevent any sort of missing values during statistical analysis. A total of 529 participants provided responses. Those who did not consent, individuals under 18 years old, and participants with unclear answers were not included in the data analysis. Therefore, 517 participants were eligible for data analysis.

2.4. Sample Size Calculation and Power of the Study

In reference to a previous study conducted by [7]), at least 400 individuals were needed to guarantee adequate statistical power, uphold a 95% confidence level, and restrict the margin of error to an acceptable 5%. The necessary sample size was determined using CDC Epi-Info software (Version 7.2) for the purpose of carrying out population surveys. A 50% anticipated frequency was selected to ensure the smallest feasible sample size.

2.5. Sampling

The study was conducted in Lebanon throughout different Lebanese regions. Convenience and snowballing methods were used to select the study sample. A link to the questionnaire was issued to known healthcare workers from across Lebanon, and these HCWs, furthermore, distributed the questionnaire to other HCWs. The participation was completely voluntary, and participants' responses were accepted only if they fit the inclusion criteria.

Inclusion Criteria:

- Healthcare workers;
- Males and females;
- Have a bachelor's degree or a professional certificate in health-related major.

2.6. Data Collection Tool

This study utilized one tool adapted from [7], which was divided into four sections. The sections included socio-demographic details (12 questions) about participants (age, gender, profession, etc.), as well as 37 questions about knowledge, attitude, and practices of HCWs regarding TB, MDR-TB, and XDR-TB. This data collection tool was founded in India and was based on WHO treatment guidelines for drug-resistant TB and the Revised National Tuberculosis Control Program (RNTCP) guidelines for management of TB and drug-resistant TB [7].

- Section 1: Socio-demographic characteristics:

The first section of this study intended to collect the HCWs' demographic data including age, gender, role in facility, level of education, duration of work in healthcare, current department (if applicable), whether they or their family members had been infected with TB before, whether they had been tested for TB, whether they are vaccinated against TB, and if they had ever received training on TB during their work in healthcare (and type of training if applicable).

- Section 2: Knowledge:

The second section aims to assess the knowledge of HCWs regarding TB, MDR-TB, and XDR-TB, such as typical signs and symptoms, high-risk population, treatment and its duration, transmission, and diagnosis. Moreover, it included questions regarding the effect of drug misuse.

- Section 3: Attitude

The third section aims to assess the attitude of HCWs regarding TB, MDR-TB, and XDR-TB. This section comprises nine questions that explore various aspects. The questions address the participants' frame of thinking about TB infection in general, their understanding of acquiring this infection, their approach towards individuals infected with TB, their perception of the severity of MDR/XDR-TB, and their viewpoint on enhancing TB infection control measures. Furthermore, it tackled the willingness of participants to be tested for TB and their interest in acquiring further knowledge about this type of infection.

- Section 4: Practice

The fourth section aims to study the HCWs' practices related to TB. The section comprised of 10 questions, which undertook the matter of suspecting TB cases, separating and prioritizing coughing patients from non-coughing patients, wearing a mask around coughing patients, especially TB patients, giving a mask to infected patients, increasing ventilation in TB patients' rooms, and providing education about TB infection and cough etiquette. A Likert scale was used in which responses were classified into 4 different categories (never, sometimes, most of the time, and always).

2.7. Measurements and Analysis Plan

The data collected were analyzed using the Statistical Package for Social Sciences IBM (SPSS-IBM), version 22 (SPSS Inc., Chicago, IL, USA). Descriptive analysis was performed on baseline demographic data, so that frequencies and percentages for each variable for the whole population of participants were computed. The qualitative data collected in the study were presented in terms of frequency percentages. Categorical variables underwent analysis using either Chi-squared or Fisher exact test. A p-value of ≤ 0.05 was deemed necessary to determine statistical significance.

2.8. Ethical Approval and Informed Consent

The Hiram Hospital's scientific and ethical committee reviewed this work and granted ethical approval. By including the consent form in the questionnaire itself, all participants will be made aware of the study and its purpose. The consent included the study's objectives and guaranteed the privacy and confidentiality of the participants' data. The data underwent anonymization and de-identification, ensuring that no identifiable information was included that could be traced back to the individuals who completed the survey.

3. Results

The total number of participants in this study was 529 HCWs, and a final number of 517 HCWs were included after data cleaning.

3.1. Sociodemographic Characteristics of HCWs

Table 1 illustrates the HCWs' sociodemographic characteristics. Most of the HCWs were females (325, 62.86%), while 192 were males (37.14%). Concerning the age, approximately half of the HCWs (285, 55.12%) were between the age of 20 to 25 years old, 152 were between 26 and 30 years old (29.4%), 59 were between 31 and 40 years old (11.41%), 16 were between 41 and 50 years old (3.1%), and 5 were older than 50 (0.97%). The median (SD) age of participants was 24 years old, while the mean age of participants was 25.66 years old.

The chosen HCWs were of different professions, including laboratory technicians (155, 29.98%), nursing (143, 27.66%), physiotherapy (96, 18.57%), pharmacy (83, 16.05%), MD (22, 4.26%), infection control (12, 2.23%), dentistry (3, 0.58%), nutrition (2, 0.38%), and radiology (1, 0.2%). The professions were grouped into medical and paramedical, with medical being 352 HCWs (68.08%) and paramedical being 165 HCWs (31.92%). Moreover, 388 of the HCWs' level of education was graduation level (75.05%), 83 were post-graduation (16.05%), 26 were BT (5.03%), and 20 were super-specialty (3.87%).

Concerning the years of experience, over half of the participants (212) had 1 to 5 years of experience (60.95%), 178 had less than 1 year of experience (34.42%), 84 had 6 to 10 years of experience (24.1%), 27 had 11 to 15 years of experience (7.76%), 8 has 16 to 20 years of experience (2.3%), and 8 had more than 20 years of experience (2.3%).

Moving on to the history of TB, 4 participants had had TB before (0.8%) while 513 participants (99.2%) had never had TB before. Also, 10 participants had had TB-infected family members (1.9%), while 507 participants had not had any TB-infected family members (98.1%). A total of 138 participants had been tested for TB before (26.7%), while the remaining 379 had not been tested for TB before (73.3%). Also, 427 participants were vaccinated against TB (82.6%), while 90 participants were not vaccinated against TB (17.4%). Lastly, only 96 participants (18.6%) had received TB training before, while the remaining 421 (81.4%) had not received any TB training before.

Table 1. Sociodemographic characteristics of participants.

Variable	Frequency (*n* = 517)	%
Gender		
Female	325	62.86
Male	192	37.14
Age		
20–25	285	55.12
26–30	152	29.4
31–40	59	11.41
41–50	16	3.1
Older than 50	5	0.97

Table 1. *Cont.*

Variable	Frequency (n = 517)	%
Profession Type		
Laboratory technician	155	29.98
Nursing	143	27.66
Physiotherapy	96	18.57
Pharmacy	83	16.05
MD	22	4.26
Infection control	12	2.32
Dentistry	3	0.58
Nutrition	2	0.38
Radiology	1	0.2
Departments		
Paramedical	352	68.08
Medical	165	31.92
Level of Education		
Graduation	388	75.05
Post-graduation	83	16.05
BT	26	5.03
Super-specialty	20	3.87
Years of Experience		
Less than 1 year	178	34.42
1–5 years	212	60.95
6–10 years	84	24.1
11–15 years	27	7.76
16–20 years	8	2.3
More than 20 years	8	2.3
History of participant with TB		
Had TB	4	0.8
Had not had TB	513	99.2
History of participant's family with TB		
Had TB	10	1.9
Had not had TB	507	98.1
TB testing		
Had been tested	138	26.7
Had not been tested	379	73.3
Vaccination		
Vaccinated	427	82.6
Not vaccinated	90	17.4
TB Training		
Received training	96	18.6
Had not received training	421	81.4

3.2. HCWs Knowledge Regarding TB, MDR-TB, and XDR-TB

Table 2 demonstrates the knowledge of HCWs regarding TB, MDR-TB, and XDR-TB. Most of the participants knew the cause of TB, accounting for a percentage of 91.88% (*n* = 475), and 89.94% (*n* = 500) knew the meaning of MDR-TB/XDR-TB, with 89.94% (*n* = 89.94%) of the participants believing that MDR-TB/XDR-TB is a genuine problem. Also, 84.72% of the participants (*n* = 438) knew the common symptoms that are indicative for active pulmonary TB. A total of 60.54% (*n* = 313) of the participants knew who had a higher risk of contracting TB than the average population, and 92.07% (*n* = 476) were knowledgeable about the existence of a relation between TB and HIV.

In relation to the transmission of TB, 99.61% (*n* = 515) of the participants knew how TB is transmitted. In addition, 85.49% (*n* = 442) of participants were knowledgeable about the means of contracting MDR-TB/XDR-TB. Moreover, 79.30% (*n* = 410) of the participants were familiar with the difference between latent TB infection and active TB disease.

Regarding the cure of TB, 79.69% (*n* = 412) of the participants believed that TB can be cured. On a similar note, concerning the cure of MDR-TB and XDR-TB, 54.16% (*n* = 280) of the participants considered the latter curable. A total of 97.49% (*n* = 5104) of participants knew the standard treatment of TB, and 84.72% (*n* = 438) knew its duration. On the other hand, only 29.01% (*n* = 74) of participants knew the treatment duration of MDR-TB/XDR-TB.

Moving on to the knowledge concerning the effects of taking TB drugs incorrectly/disrupting the treatment, 84.14% (*n* = 435) of the participants were aware of such effects. Also, 66.43% (*n* = 343) believed that someone can still contract TB even if one is vaccinated with BCG.

Furthermore, with respect to the diagnosis of TB, only 20.70% (*n* = 107) of the participants knew the most frequently used diagnostic test to diagnose TB. Similarly, only 14.31% (*n* = 74) of the participants knew about the diagnostic methods available for diagnosing MDR-TB/XDR-TB. In contrast, a staggering 40.81% (*n* = 211) were aware that the causative agent of TB can be detected via PCR (GeneXpert) within 2 to 3 h.

Table 2. Knowledge of HCWs regarding TB, MDR-TB, and XDR-TB.

Question		Correct	Incorrect
What causes TB?	*n*	475	42
	%	91.88%	8.12%
What are the typical/common symptoms that are used as an indicator for active pulmonary TB?	*n*	438	79
	%	84.71%	15.29%
Can TB be completely cured?	*n*	412	105
	%	79.69%	20.31%
How is TB transmitted?	*n*	515	2
	%	99.61%	0.38%
What is the standard treatment for TB?	*n*	504	13
	%	97.48%	2.51%
How long does the standard treatment for drug-sensitive (TB responding well to therapy) TB of the lungs (pulmonary TB) usually take?	*n*	438	79
	%	84.71%	15.28%

Table 2. *Cont.*

Question		Correct	Incorrect
What can happen if you take your TB drugs incorrectly/disrupt TB treatment?	*n*	435	82
	%	84.13%	15.86%
Who has a higher risk of contracting TB than the average population?	*n*	313	204
	%	60.54%	39.45%
Can you contract TB when you are vaccinated with BCG?	*n*	343	174
	%	66.34%	33.66%
Is there a relationship between HIV and TB?	*n*	476	41
	%	90.32%	7.93%
What is the most frequently used diagnostic laboratory test to diagnose TB?	*n*	107	410
	%	20.69%	79.30%
Do you know that the causative agent of TB can be detected via PCR (GeneXpert) within 2–3 h?	*n*	211	306
	%	40.81%	59.19%
What is the difference between latent TB infection and TB disease?	*n*	410	107
	%	79.30%	20.7%
What is MDR-TB/XDR-TB?	*n*	500	17
	%	96.71%	3.29%
Is MDR-TB/XDR-TB a genuine problem?	*n*	465	52
	%	89.94%	10.06%
How can you contract MDR-TB/XDR-TB?	*n*	442	75
	%	85.49%	14.51%
Is MDR-TB/XDR-TB curable?	*n*	280	237
	%	54.16%	45.84%
Do you have knowledge about the treatment duration of MDR-TB/XDR-TB?	*n*	150	367
	%	29.01%	70.99%
What are the diagnostic methods available for diagnosing MDR-TB/XDR-TB?	*n*	74	443
	%	14.31%	85.69%

3.3. HCWs Attitude Regarding TB, MDR-TB, and XDR-TB

Table 3 provides the HCWs' attitude regarding TB, MDR-Tb, and XDR-TB. A total of 56.09% of participants (*n* = 290) believed that they could contract TB, but only 13.92% of HCWs (*n* = 72) fear contracting TB. As for perceiving TB, MDR-TB, and XDR-TB as a major public health threat, 58.08% of participants (*n* = 304) considered the mentioned subjects to be posing a substantial threat.

Regarding the perception of TB, MDR-TB, and XDR-TB patients, 83.37% of participants (*n* = 431) would not continue to socialize with a friend diagnosed with TB. On a similar note, only 0.97% of participants (*n* = 5) were willing to share cutlery with TB-infected family members, leaving 99.03% of participants (*n* = 512) not willing to share cutlery with TB-infected family members.

As for viewing TB, 84.33% of participants (*n* = 436) believed that TB is a stigmatized disease, leaving only 15.67% of participants (*n* = 81) unwilling to call TB a stigmatized disease.

Regarding the desire to learn more about tuberculosis, 96.13% of participants (*n* = 497) expressed a willingness to do so. Additionally, 74.85% of participants (*n* = 387) were

inclined to be tested for tuberculosis on a regular basis. Finally, just 19.34% of participants (n = 100) thought that their region needs to improve its TB control.

Table 3. Attitude of HCWs regarding TB, MDR-TB, and XDR-TB.

Question		Yes	No
Do you think you could contract TB?	*n*	290	227
	%	56.09%	43.91%
Are you scared of contracting TB?	*n*	72	445
	%	13.93%	86.07%
Would you continue to socialize with your friend if s/he was diagnosed with TB?	*n*	86	431
	%	16.63%	83.37%
Would you share the same cutlery, plates, and glasses with a family member, if s/he was infected with TB?	*n*	5	512
	%	0.96%	99.03%
Would you say that TB is a stigmatized disease?	*n*	436	81
	%	84.33%	15.67%
Would you like to learn more about TB?	*n*	497	20
	%	96.13%	3.87%
Would you be willing to be tested for TB regularly?	*n*	387	130
	%	74.87%	25.13%
Do you feel TB/MDR-TB/XDR-TB is a major threat to public health?	*n*	304	213
	%	58.08%	41.92%
Do you think there is a need for improvement in TB control in your region?	*n*	100	417
	%	19.34%	80.66%

3.4. HCWs' Practices Regarding TB, MDR-TB, and XDR-TB

Table 4 presents the different self-reported practices of HCWs regarding TB, MDR-TB, and XDR-TB. Concerning the practices of dealing with coughing patients, the majority of participants (n = 387; 74.85%) sometimes suspected TB in a patient who had been coughing for one month. Similarly, as for separating coughing patients from other patients, over half of the participants will sometimes separate such patients (n = 342; 66.15%) and approximately a quarter of the participants will most of the time perform such a separation too (n = 115; 22.24%).

As for dealing with coughing patients, about 88.59% of participants (n = 458) will always wear a mask. This percentage is increased to reach 92.84% (n = 480) when the coughing patient is a confirmed active TB case, causing more HCWs to always wear a mask when dealing with such a patient. Also, about half of the participants (n = 280; 54.16%) will most of the time hand coughing patients a mask upon their arrival, and 123 participants (23.79%) will always give out a mask to ensure cough hygiene. Furthermore, the majority of participants (n = 371; 71.76%) will sometimes prioritize coughing patients upon arrival at the healthcare facility, and a minority (n = 27; 5.22%) will always prioritize such patients.

Moving on to environmental control, 205 participants (39.96%) and 191 (36.94%) will sometimes and most of the time open windows and doors to increase natural ventilation, respectively. Moreover, 79 participants (15.28%) will most certainly use such means to increase ventilation, leaving a small percentage of participants who never open doors and windows in a TB patient room (n = 42, 8.13%). On the contrary, only 20 participants (3.87%) will always

turn on a fan in a TB patient's room for ventilation, while the majority of the participants' responses varied between never (n = 117; 22.63%) and sometimes (n = 238; 46.03%).

Lastly, concerning awareness towards cough etiquette, the majority of participants will educate patients about the means of cough etiquette (n = 445; 89.94%), and 397 participants (76.79%) reported that they will provide education towards TB to newly diagnosed TB patients.

Table 4. Practices of HCWs regarding TB, MDR-TB, and XDR-TB.

HCWs Practices		Never	Sometimes	Most of the Time	Always
When a patient says he has been coughing for a month, I suspect TB.	*n*	30	387	97	3
	%	5.80%	74.85%	18.77%	0.58%
I separate coughing patients from other patients	*n*	10	342	115	50
	%	1.94%	66.15%	22.24%	9.67%
When I deal with a coughing patient, I wear a mask.	*n*	Nil	22	37	458
	%	0%	4.25%	7.16%	88.59%
When I deal with a confirmed active TB patient, I wear a mask.	*n*	5	8	24	480
	%	0.97%	1.55%	4.64%	92.84%
I give patients who arrive with a cough a mask.	*n*	8	106	280	123
	%	1.55%	20.50%	54.16%	23.79%
When a TB patient is in the room, I open windows and doors to increase natural ventilation.	*n*	42	205	191	79
	%	8.13%	39.65%	36.94%	15.28%
When dealing with a TB patient, I turn on the fan to increase ventilation.	*n*	117	238	142	20
	%	22.63%	46.03%	27.47%	3.87%
When a patient arrives at my facility with a cough, I prioritize him/her in comparison to patients without cough.	*n*	49	371	70	27
	%	9.48%	71.76%	13.54%	5.22%
If a patient is newly diagnosed with TB, I give him/her information about his/her disease.	*n*	26	94	136	261
	%	5.03%	18.18%	26.31%	50.48%
I explain to coughing patients how they can practice cough hygiene, in order to avoid infecting other people around them.	*n*	3	49	115	350
	%	0.58%	9.48%	22.24%	67.7%

3.5. Correlation Between HCWs' Knowledge, Attitude, Practices, and Sociodemographic Characteristics Regarding TB, MDR-TB, and XDR-TB

The correlation between HCWs' knowledge, attitude, practices, and sociodemographic characteristics regarding TB, MDR-TB, and XDR-TB was assessed. Any p-value less than 0.05 was considered to be significant.

Regarding gender, although the highest average knowledge score was seen in females (11.42), the ANOVA test yielded a p-value of 0.598, indicating that there is no statistically significant difference in the knowledge scores between males and females. Similarly, the highest attitude and practices score was also seen in females with a mean score of 4.72 and 5.28, respectively. The p-value calculated for the parameters mentioned above were 0.3100 and 0.1516, respectively, indicating that there is no statistically significant difference between genders regarding attitude and practices.

Moving on to age, the highest average knowledge score was seen in participants aged between 26 and 30 with a mean score of 12.0. However, the p-value was 0.598, indicating that there is no statistically significant difference in the knowledge between all age groups. On the same note, the HCWs aged from 26 to 30 scored the highest attitude

score with a mean of 4.84, but the *p*-value (0.5308) showed that there is no statistically significant difference in attitude between all age groups. As for the practices, the age group over 51 years old displayed the highest average practices score of 5.4, but the *p*-value (0.9205) revealed that there is no statistically significant difference between all age groups regarding practices.

In relation to the responsibilities within the facility, the medical personnel demonstrated a higher level of expertise compared to the paramedical staff, achieving an average knowledge score of 11.43. Despite that fact, a *p*-value of 0.2842 was calculated indicating that there is no significant statistical difference between both medical and paramedical staff with knowledge. The same goes for practices, where the medical staff scored the highest average knowledge score (5.11), but the *p*-value (0.8161) was indicative of the lack of a statistically significant difference between medical and paramedical staff concerning practices. On the contrary, the paramedical staff yielded the highest average attitude score (4.85), yet the *p*-value (0.2927) indicated that there is no statistically significant difference between medical and paramedical staff with attitude.

As for the current departments, the HCWs from the physiotherapy department were the most knowledgeable with a mean knowledge score of 16. Despite that, the *p*-value calculated was 0.5061, showing that there is no statistically significant difference between different departments regarding knowledge. However, HCWs from the infection control department obtained the highest average attitude and practice scores (5.33 and 7.0, respectively); nevertheless, the *p*-value (0.8703 and 0.3016, respectively) indicated that there is a lack of a statistically significant difference in all departments regarding attitude and practices.

With respect to the level of education, the highest average scores were seen in superspecialty groups in all knowledge, attitude, and practices sectors. The *p*-value calculated was not significant in all sectors (0.913, 0.110, and 0.383, respectively), which expresses the absence of any statistically significant difference in all levels of education in terms of knowledge, attitude, and practices.

With regard to the years of experience, group 2 (6 to 10 years) had the highest average knowledge score out of all groups, but the *p*-value 0.780 implied that there is not any statistically significant difference between all years of experience. On the same note, although group 5 (more than 50 years) and group 4 (16–20 years) yielded the highest attitude and practices average scores, respectively, the *p*-value of both sectors indicated that there is no statistically significant difference in all years of experience regarding attitude and practices.

As to previous diagnosis with TB, both attitude and practices sectors were of insignificant *p*-values, indicating that there is no statistically significant difference in the attitude and practices of participants between whether one is previously diagnosed with TB or not. On the contrary, the knowledge sector showed a *p*-value of 0.058, which is just above 0.05. This slight significance can be explained by the fact that only four participants had been diagnosed with TB before, so if there was a bigger sample diagnosed with TB then the significance might have been displayed more.

Concerning previous testing for TB, the highest average scores in all sectors (knowledge, attitude, and practices) were seen in participants who had previously been tested for TB (average scores of 12.88, 5.80, and 4.99, respectively). As for the *p*-value, it was recorded as significant in the practices category (*p*-value = 0.000312) only, indicating that participants who had previously been tested for TB were more knowledgeable about TB, MDR-TB, and XDR-TB than those who had not been tested before.

Regarding family history with TB (whether participants had TB-infected family members or not), the highest knowledge average score was seen in participants who had had

TB-infected family members, with a mean knowledge score of 12.71. However, the attitude and practices highest average scores were displayed in participants who had not had TB-infected family members with mean scores of 5.6 and 6.3, respectively. As for the *p*-value, the knowledge sectors yielded an insignificant *p*-value of 0.207, indicating that there is no statistically significant difference in the knowledge of participants who had and had not been exposed to infected TB family members. On the contrary, both attitude and practices showed a statistically significant difference with *p*-values of 0.036 and 0.018, respectively, which implied that the attitude and practices of participants who had had TB-infected family members were ahead of those who had not had any TB-infected family members.

With reference to the vaccination status of participants, the highest knowledge scores were seen in vaccinated participants (average knowledge score of 13.12). Surprisingly, both attitude and practice scores were higher in participants who had not received the TB vaccine (average attitude score of 4.71 and average practices score of 5.71). However, all sectors were shown to be insignificant, as suggested by *p*-values of 0.061, 0.203, and 0.184 for knowledge, attitude, and practices, respectively.

The final sociodemographic characteristic, pertaining to TB training, revealed no statistically significant differences across all KAP sectors, as evidenced by *p*-values of 0.182, 0.097, and 0.131 for knowledge, attitude, and practices, respectively.

3.6. Correlation Between Knowledge, Attitude, and Practices of HCWs Regarding TB, MDR-TB, and XDR-TB

The correlation between knowledge and attitude, knowledge and practices, and attitude and practice scores were assessed.

In Table 5, *p*-values are presented regarding KAP scores. Firstly, the remarkably small *p*-value indicates a statistically significant distinction between knowledge scores and attitude scores, implying that, typically, the scores on these metrics significantly vary, with knowledge scores tending to be higher than attitude scores. This significant difference emphasizes that even though individuals may possess information regarding TB, it may not automatically result in the same level of attitude towards the disease.

Table 5. Correlation between HCWs KAP regarding TB, MDR-TB, and XDR-TB.

Scores	*p*-Value
Knowledge and Attitude	1.32×10^{-252} *
Knowledge and Practices	6.72×10^{-234} *
Attitude and Practices	5.76×10^{-5} *

*: Statistically significant.

Secondly, the extremely small *p*-value indicates a statistically significant distinction between knowledge scores and practice scores. This implies that, typically, the scores on these two metrics differ significantly, with knowledge scores tending to be higher than practice scores. This notable contrast indicates that, although individuals may have knowledge about TB, it does not automatically result in practical actions at an equivalent magnitude.

Lastly, the extremely small *p*-value indicates a statistically significant distinction between attitude scores and practice scores. This implies that, typically, the scores on these two assessments are notably dissimilar, with attitude scores tending to be higher than practice scores. This notable contrast highlights the fact that, although individuals may hold favorable attitude towards TB, it does not automatically result in equivalent levels of practical implementation.

4. Discussion

The focus of this study was to assess healthcare workers' knowledge, attitude, and practices regarding TB, MDR-TB, and XDR-TB and try to find a correlation that may explain the gaps found, if any. This section examines the present research outcomes pertaining to HCWs' knowledge, attitude, and practices towards TB and MDR-TB/XDR-TB, as well as sociodemographic factors that may be affecting them. One notable aspect of this research is its limited scope, as it has only been conducted in India [7]. Consequently, there is a lack of existing evidence from other regions. Nevertheless, this study established a link between these discoveries and the existing body of literature.

The sociodemographic information revealed that only 4 HCWs had been diagnosed with TB, and only 10 had TB-infected family members. A total of 28.7% of the participants had been tested for TB and a staggering 82.6% had already been vaccinated against TB. Only 18.6% reported that they had received training on TB before. Here, we can see that the minority were trained for TB-related issues by the time that training programs could be of great benefit to increase knowledge regarding this topic. Similar findings were shown in a study carried out in Nigeria, where less than half of the HCWs reported being provided with training on MDR-TB [9]. As a result, it is essential to allocate additional time for conducting training sessions and to schedule them according to the availability of healthcare workers (HCWs) to maximize attendance.

In this study, it was revealed that there is a gap in the knowledge of HCWs regarding the diagnosis and treatment of TB and MDR-TB/XDR-TB. For instance, only 20.70% of participants knew the most frequently used diagnostic test for TB diagnosis, and only 14.31% were knowledgeable about the means of diagnosing MDR-TB/XDR-TB. These results contradicted the fact that, surprisingly, 40.81% of participants knew that the causative agent of TB can be detected using PCR (GeneXpert) within 2–3 h. On the other hand, our results were complementary to other research papers, such as [7], who found that most of his study participants did not have enough knowledge about the diagnosis of MDR-TB/XDR-TB but did not mention a gap in non-resistant TB diagnosis. On the same note, only 29.01% of the participants in our study knew the correct treatment duration for MDR-TB and XDR-TB, which also complements the findings of [7], who found that participants lacked adequate knowledge regarding the treatment of resistant TB. As reference to that, if HCWs are not properly educated about the treatment and diagnosis of TB, MDR-TB, and XDR-TB, then it is extremely hard to control TB infections, since treatment and diagnosis play a huge role in TBIC. Without treatment and diagnosis, the infection will neither be cured nor discovered in the first place, making it very easy to witness a staggering increase in resistance and maybe an outbreak [7]. However, other studies revealed that the average knowledge score was average-to-low, where less than half of the participants had good knowledge levels [10]. Also, another study revealed that low knowledge was indicated in HCWs regarding MDR-TB, and this lack of knowledge was mostly related to the educational status as well as a previous history with TB [11]. Moreover, a study conducted in Nepal found that almost half of the HCWs' knowledge was poor, and this lack of knowledge was also mainly caused by educational status as well as a lack of TB training [12]. This indicates that, even if knowledge may range from good to average, that does not exclude certain gaps that should be assessed and worked upon to ensure adequate knowledge.

Most HCWs (71.95%) had average attitude towards TB, MDR-TB, and XDR-TB. However, HCWs are one of the most susceptible individuals to TB infections due to their direct contact with confirmed or unconfirmed TB cases and are continuously in the front line of TB treatment and control; hence, it is crucial for them to have positive attitude toward such topics. A study carried out in Nigeria revealed that the overall attitude of HCWs regarding compliance with TB infection control measures were good [13]. On the contrary, a study

carried out in Ethiopia had somewhat similar findings as our study, where it is declared that slightly over half of HCWs had positive attitude towards TB-infected individuals, which translates to average or slightly bad attitude [14]. Our study revealed that only 13.93% of participants fear contracting TB, which is very dangerous, because HCWs are most frequently directed towards patients who may have a TB infection. Also, only 5% of the participants are willing to share cutlery with TB-infected individuals. This highlights the misconceptions in knowledge, not only attitude, since we can conclude that there is a gap regarding the mode of transmission of TB, where they believe that it can be transmitted through cutlery. This misconception further perpetuates the stigma surrounding this illness. As proof, our findings have already demonstrated that most respondents (84.33%) perceive TB as a stigmatized condition. It is also important to mention that our findings are also complementary with [7]'s findings, where they discovered that a lot of their participants refused to share the same cutlery with TB-infected individuals, which can further promote stigmatization, and 72% of the participants already categorized TB as a stigmatized disease. Also, concerning the stigmatization of TB, other studies have demonstrated this issue, including [13], which displayed the perception towards TB and how is it perceived as a stigmatized disease. As a matter of fact, a study conducted in southern Mozambique reported that 70% of the participants (HCWs) regarded TB as stigmatized [15], while another study conducted in Nigeria displayed that poor perceptions of TB were mainly caused by the stigmatization of the disease [9].

It is valuable to mention that 89.93% of participants perceive MDR-TB/XDR-TB as a genuine problem, with 96.13% willing to learn more about TB, and 84.82% stating their willingness to be regularly tested for TB. Although these results are fortunate, only 19.34% of the participants reported that they believe that there is a need for TB control improvement in their region. This contradiction might be either due to the fact that there are certain misconceptions regarding TB control and its means, or there is a lack of sense towards the importance of TB control and the significance of the continuous improvement of such measures. Our results were partially complementary with [7]'s findings, where in their study, HCWs admitted to the need of TBIC improvement and also viewed MDR-TB/XDR-TB as a major health problem.

Regarding practices, many participants stated that they wore masks when interacting with coughing patients (who were either undiagnosed or diagnosed with tuberculosis), even though the score ranged from average to poor. This compliance is very crucial in TBIC, since TB is transmitted through aerosols upon coughing or sneezing. A major problem that we might face in Lebanon is the lack of resources that may limit TBIC control. For instance, many hospitals do not provide the N95 masks needed for TB prevention, and conventional surgical masks offer very reduced benefit. These masks can be worn by infected patients themselves, but it is better for HCWs to wear an N95 mask [16]. Furthermore, most participants are willing to give patients who arrive coughing masks but with different certainty. The implementation of such an action is very beneficial in TBIC, but then again, this performance may be hindered by the lack of resources. Returning to the point regarding the average-to-bad practice scores, our results were complementary with a study carried out in Ethiopia, where practice levels were low concerning TB and MDR-TB [11]. Also, with respect to another study carried out in Maseru, the practice levels were also reported to be low, with many participants not adhering to using protective masks while attending to TB patients [10].

Concerning natural ventilation, only 15.28% of participants always open doors and windows to increase ventilation, and only 3.87% of participants always use fans to increase ventilation. Natural ventilation can help in reducing TB spread, but of course, only if this is managed in a proper manner (windows that are facing outdoors should be open, and fans

should be directed away from hospital halls and visitors) [17]. More awareness should be directed towards such a topic, since it is evident that there is a lack of knowledge regarding the effectiveness of natural ventilation, which is not only efficient but cost-friendly.

Also, it is fortunate that most participants are willing to provide newly diagnosed TB patients with information about the disease, as well as teach them cough etiquette. These practices mentioned before are extremely important in maintaining TB infection and preventing its spread. These results are complimentary to [7]'s finding, where they also found out that a significant number of their participants were also willing to give such education.

Furthermore, in our study, the data showed that attitude are best in HCWs who had already been diagnosed with TB as well as in HCWs who have had TB-infected family members. However, our study did not show the association of the participants' own history with TB with any of the assessed sections, and that contradicted with a conducted study that connected a lack of knowledge to a lack of previous history with TB [11]. Our study only had four participants who had already been diagnosed with TB, so maybe if the number was higher (i.e., the sample contained more participants with a history of TB), then the findings may be more similar to the ones mentioned before concerning the association between knowledge and history. Also, the practices were best viewed in HCWs who have had TB-infected family members. Unfortunately, there are not enough studies carried out yet on such a topic, and therefore, currently, there are not any other findings to compare ours to. Moreover, our data showed that the participants had good knowledge, average-to-good attitude, and average-to-bad practices. The knowledge exceeded both attitude and practices, but the attitude scores exceeded the practices. Hence, it is important to start tackling such gaps and to try to improve as much as possible in TBIC.

It is important to address such issues, since the rise of antimicrobial resistance (AMR) is an escalating global public health concern, with antibiotic use increasingly identified as the primary factor contributing to the development of this resistance [18]. For example, in a study carried out in Italy, there has been a noticeable increase in the prevalence of antibiotic-resistant bacteria. Specifically, the percentage of CPO cases rose from 2.62% to 4.56%, MRSA cases went up from 1.84% to 2.81%, and VRE cases climbed from 0.58% to 2.21%. This growing trend in antimicrobial resistance has led to a higher incidence in both CPO and MRSA cases across community and healthcare settings [19]. On this note, it is important to start working on finding new strategies to combat such resistance and maybe find alternative ways in treating infections that are beyond the commonly used drugs [20,21].

The cross-sectional design utilized in our study restricted our capacity to track changes in HCWs' perceptions across different time periods. Furthermore, there are not many similar published articles to compare our findings. Also, the data collection was carried out across Lebanon, but the questionnaire did not include a question about the region of participants, and hence, the percentage distribution of the participants across different Lebanese regions is not known. Another limitation in the present study is the use of an online survey, which made it more difficult to determine the number of non-responses or potential biases. Despite these few constraints, our research has contributed fresh insights to the literature by presenting new data on the KAP of HCWs regarding TB, MDR-TB, and XDR-TB and their perceptions toward such infection. Finally, HCWs can integrate broader TB control strategies through actively participating in early detection, the education of patients, and treatment adherence support. Also, they can collaborate with different public health programs to conduct screenings, report cases, and promote infection prevention and control measures.

5. Conclusions

In conclusion, the results of this research indicate that there is an overall good knowledge level regarding TB, MDR-TB, and XDR-TB, with average attitude, and practices ranging from average to bad. Deficiencies and gaps are seen in all sectors, even the one related to knowledge. In the knowledge section, there were gaps regarding the diagnosis of Tb and MDR-TB/XDR-TB and the treatment of MDR-TB/XDR-TB. Additionally, the attitude section highlighted a lack of knowledge regarding the mode of transmission of TB. Moreover, there is a trend of referring to TB as a stigmatized disease and refraining from sharing any sort of cutlery with TB-infected patients. Furthermore, our results proved that natural ventilation is not appreciated as much as it should be. It is highly recommended to schedule training sessions and educational programs regarding the diagnosis, transmission, treatment, and risk of contracting TB or its resistant forms. For example, education can be administered using technologies such as the S9.6-based hybrid capture immunoassays [22] and stool-based molecular assays [23]. Similarly, the role of post-translational modifications can be explained in the development of drug resistance in Mycobacterium tuberculosis [24]. Also, it is advised to start changing the image of TB and try to educate individuals, so that TB is no longer a stigmatized disease. Also, it is important to highlight the importance of natural ventilation and its efficiency.

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