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The Potential Role of Community Pharmacy in Tuberculosis Case Detection: A Multicentre Cross-Sectional Study in a High-Burden Tuberculosis Setting

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ABSTRACT

Introduction: Control of tuberculosis (TB) is hampered by suboptimal case detection and subsequent delays in treatment, which is worsened by the COVID-19 pandemic. The community pharmacy is reported as the place for first aid medication among patients with TB. We, therefore, analysed knowledge, attitude, and practice (KAP) on TB case detection (TBCD) of the community pharmacy personnel, aiming to find innovative strategies to improve TBCD in the high-burden TB setting.

Methods: A multicentre cross-sectional study was performed in four areas representing Indonesia's eastern, central and western parts. Both pharmacists and pharmacy technicians who worked in the pharmacy were assessed their characteristics and KAP related to TBCD. Descriptive and regression analyses were used for the analyses.

Results: A total of 1,129 participants from 979 pharmacies, comprising pharmacists (56.6%) and pharmacy technicians (43.4%), were included in this study. Most participants knew about TB. However, knowledge related to TB symptoms, populations at risk, and medication are still suboptimal (<60%). Most participants showed a positive attitude on TBCD. They believed in their professional role (75.1%), capacity in TB screening (65.4%), and responsibility for TBCD (67.4%). Nevertheless, a lack of TBCD practice was identified in most participants, highlighting other factors affecting the practice. We analyzed factors associated with providing a TBCD practice, such as training experience (Beta coefficient (B)= 0.83; p<0.00), provision of a drug consultation service (B= 0.68; p<0.00), male gender (B= 0.41; p= 0.04), positive attitude (B= 0.34; p<0.00), working hours (B= -0.16; p<0.00), and peripheral location of the pharmacy (B= -0.52; p= 0.03).

Conclusions: The community pharmacy is a potential facility to support TBCD. However, exposure of TB training to the personnel and an integrated program with the national TB program is required. Further study is needed to comprehensively identify the local determinants and partnership strategies for engaging community pharmacies in TBCD.

Keywords: pharmacy, KAP, tuberculosis, Indonesia

Strengths and limitations of this study

- This is the first study that explicitly analyzes the knowledge, attitude, and practice tuberculosis (TB) case detection among community pharmacies in Indonesia.
- A total of 1,129 participants from 979 pharmacies is included in this study, obtained from Indonesia's western, central, and eastern parts.
- Relevant stakeholders are involved in developing a research question and performing this study to improve the quality, safety, value, and sustainability of health systems and research.
- This is a self-reported study that may raise the social desirability bias
- The association between the factors and study outcome cannot be framed in the causality concept since the nature of the cross-sectional study does not consider the time difference between the causal factors and the effect

INTRODUCTION

Tuberculosis (TB), a disease caused by *Mycobacterium tuberculosis* (M.tb), remains an immense global health problem. The most recent TB report of the World Health Organization (WHO) estimated that its global incidence is about 9.9 million people, with total mortality around 1.3 million people in 2020[1]. The global treatment coverage is still low with great concern about multi-drug resistant tuberculosis (MDR-TB), i.e., the pathogen's resistance to at least two powerful anti-tuberculosis drugs (isoniazid and rifampicin). Global data showed that the success rate of MDR-TB treatment is only about 59%[1]. The TB problem gets more complex when it is considered that the COVID-19 pandemic affects TB case detection.

Globally, TB notification significantly decreased from 7.1 million (2019) to 5.8 million (2020)[1]. The high-burden TB countries were reported as the largest contribution to the global shortfall in TB notification, such as India, Indonesia, Philippines, China, Bangladesh, and Pakistan. Indonesia is in the third rank of the high TB burden countries with around 824 thousand people contracted TB[1]. TB case notification in Indonesia significantly dropped from 566.8 thousand (2019) to 393.3 thousand (2020) due to the COVID-19 pandemic[1]. The WHO report highlights that potential undetected TB cases in the high-burden TB countries should be identified to control disease-spreading, drug resistance and improve treatment outcomes.

The community pharmacy is a potential facility that can help detect TB cases[2]. Studies in the high-burden TB countries showed that most TB patients initially present at the pharmacy for their first aid medication[3–8]. However, improper management of TB cases in pharmacies can lead to delayed diagnosis and inappropriate treatment[9,10]. A study in Indonesia estimated that the total delay is caused by various reasons, including visiting a pharmacy for the initial aid medication[3]. A qualitative study also showed that delayed TB diagnosis occurred when the TB patient received inappropriate treatment recommendations from a pharmacy[11]. Improper TB case management in the pharmacy might be due to poor TB knowledge, attitude, and practices from the pharmacy personnel. All this information suggests that improving TB care in the community pharmacy is needed to enhance the practice of TB screening and refer the suspected TB patient to the health care facility to support TB case detection.

However, there is still limited or no systematic and comprehensive guidance on the involvement of pharmacies for TB case detection, including in Indonesia. As a base for such guidance, a first study is needed to analyse the current situation and determinants for practising TB case detection among community pharmacies. Therefore, we conducted a multicentre cross-sectional study to analyse the characteristics, knowledge, attitude, and current practice of the pharmaceutical personnel in the community pharmacy regarding TB

case detection in Indonesia. To the best of our knowledge, this is the first study on this topic for the setting, and it will be beneficial to develop innovative strategies to increase TB case detection in the high-burden TB countries, including Indonesia.

METHODS

Study design and setting

A cross-sectional study was performed in three major cities representing the western, central, and eastern parts of Indonesia, namely Medan, Bandung, and Makassar. To include the peripheral area of Indonesia, we also added an accessible peripheral area in the county of Bandung as a study site. Thus, four areas were defined as the study location. Makassar is the capital of South Sulawesi, located in the eastern part of Indonesia, with a 2,847,754 population[12], while Medan is the capital of North Sumatera, located in the western part of Indonesia with a 2,681,830 population[12]. In the central part, the city of Bandung, West Java's capital, was selected as the study setting with a total population of 2,510,103[12]. In addition, the county of Bandung has a total population of 3,831,505[12], located around 50 kilometres from the city of Bandung.

In Indonesia, a pharmacy called *apotek*, is a community pharmacy managed by the private sector. It can be a chain pharmacy or an independent pharmacy. According to the national regulation, a pharmacy is a facility where a pharmacist performs pharmaceutical practices in the community[13]. Hence, a pharmacy must be under the authority of a pharmacist who holds a professional degree of pharmacy and pharmaceutical license from the Ministry of Health, Republic of Indonesia. One or more pharmacy technicians support a responsible pharmacist in a pharmacy. A pharmacy technician should hold a pharmaceutical practice license from the government and have the formal pharmaceutical education at least in the pharmaceutical vocational school, equivalent to senior high school education level[13].

Participants

We included participants who have an educational background as a pharmacist or a pharmacy technician; are working as pharmaceutical workers at the community pharmacy; and have experience in the pharmacy for at least six months. We excluded participants if they worked outside the pharmacy (e.g., in a community health centre, hospital) or were underqualified according to the national regulation.

Data were obtained from July to October 2021 using so-called gatekeepers in each study site. The gatekeepers were representatives of the local professional pharmaceutical organisation

related to the research participants, and they were supported by researchers at each study site (ISP, Kh, MAB, MNK).

Study size

We used pharmacies as the unit sample in this study. An estimated 1,800 pharmacies in all the study sites were defined as the sample frame, considering the government and professional organisation data[14]. This study used an online Raosoft® sample size estimator to identify a minimum sample size [15]. In view of a 5% of margin error, 95% confidence level, and 50% response distribution, we identified a total of 317 pharmacies as the minimum sample size in this study. In light of the pandemic COVID-19 situation, we approached the pharmacies using online and offline research instruments. The geographical distribution of the pharmacies and its personnel were identified and followed up by the gatekeepers. According to the gatekeeper's data and networking, data collection was performed considering the pharmacy distribution at the sub-district level.

Questionnaire development and validation

A validated questionnaire was developed as the instrument for data collection. The questionnaire was developed based on the guideline for knowledge, attitude, and practice survey in TB published by WHO[16], the Indonesian national TB guideline[17], the expert's consensus on the physiological factors for implementing evidence-based practices[18], and previous relevant studies[19–21].

We defined four assessment domains, i.e., the participant's characteristics, knowledge, attitude, and practice in TB case detection. The domain for participant characteristics consisted of age, marital status, professional background, educational level, study site, working experience, an average of working hours per week, type of pharmacy (chain/ independent pharmacy), number of pharmacies for the pharmaceutical practice, availability of physician practice in pharmacy, providing drug consultation services, and experience in TB training.

We assessed TB knowledge related to activities in TB detection, i.e., TB pathogenesis, transmission, symptoms, risk population, diagnosis, and medication. Given the expert's consensus on the essential psychological determinants for implementing evidence based practice[18], the attitude domain was operationalised as the beliefs in the professional role, capability, and consequences of the activities for TB case detection. Finally, we defined practices of TB case detection as the activities in the screening of TB signs and symptoms, communicating with TB health care workers, and referring the suspected TB patient to the health facility for further examination in the sixth last months.

The participant's characteristics domain items were assessed using closed and short open questions, while the item of knowledge domain was measured on a nominal scale (true, false, and do not know). Five Likert scales were used for the attitude and practice domain items. We used "strongly agree", "agree", "doubt", "disagree", and "strongly disagree" for the attitude items, and "very often", "often", "sometimes", "rarely", and "never" for the frequency of practice items. To have a clear definition, we defined "very often" as the practice performed at least every week; "often" is the practice performed at least once a month; "sometimes" is the practice performed at least once 2-4 months; "rarely" is the practice performed once 5-6 months; and "never" is never doing the practice in the last six months.

We assigned the questionnaire for face and content validation to experts with several backgrounds, i.e., an epidemiologist, a pharmacist, an assistant pharmacist, and a TB specialist. In light of the expert judgments, ISP (TB researcher) and EF (statistician and item developer) finalised the items. A pilot study involving 200 participants who were different from the participants was conducted for the validity and reliability test of the instrument.

Statistical analysis

The pilot study tested the item validity by comparing the coefficient validity (r) and its reference. Items were valid if the r calculation was higher than the r reference (0.13 for 200 participants)[22]. The reliability test was conducted by identifying Cronbach's alpha that should be more than 0.60 for an acceptable reliability item[23,24].

Descriptive statistics were used to analyse the characteristics of participants. Categorical data were described as numbers and percentages. Median and interquartile range (IQR) were used for continuous and non-normally distributed data. As to the knowledge domain, percentages of participants who had correct answers per item were reported, while in the attitude and practice domain, percentages referred to participants who chose a particular scale in the items.

We performed regression analyses to identify factors associated with the practice of TB case detection. The normality of the residual was identified by assessing the shape of the residual histogram and probability-probability (P-P) plot. Multicollinearity was evaluated by identifying the variance inflation factor (VIF) less than 5[25]. For a comprehensive analysis, we analysed risk groups for poor TB knowledge and attitude as the dependent variables. Significance levels were set at 5% with a 95% confidence interval (CI). Data management and analysis were performed anonymously, and the analyses were conducted using SPSS version 26.

The strengthening of the reporting of observational studies in epidemiology (STROBE) guideline for a cross-sectional study was followed to have systematic and transparent study reporting[26].

Patient and Public Involvement

The research question was developed considering the previous interviews and focus group discussions involving TB patients, a non-governmental organization, health service providers, and pharmacists. We involved the representation of professional organizations in pharmacy for data collection. The research will be disseminated in the relevant scientific forum involving pharmacists and technician pharmacists.

RESULTS

Pilot study

In the phase of questionnaire development, all experts agreed that all items could be used for the research instrument. All items fulfilled the face and content validity with minor structural and content revisions. A total of 40 items was developed to assess participant characteristics (16), knowledge (17), attitude (4), and practice (3). After being revised, we distributed the items to 200 participants for the validity and reliability test.

The knowledge, attitude, and practice items were valid since the coefficient validities were identified from 0.15 to 0.88. Similarly, all the knowledge, attitude, and practice items were reliable items since Cronbach's alpha's were identified from 0.63 to 0.79. The participants' characteristics, validity, and reliability test in the pilot study can be seen in **Supplementary files 1, 2**, and **3**, respectively.

Main study

The validated questionnaire was distributed to all study sites in the main study. The participants were obtained from 979 pharmacies across the study sites, with 1,242 subjects. However, we excluded 113 subjects due to an under-qualified education level (4) and working outside of the community pharmacy (109). Finally, we included 1,129 participants for further data analysis. The flow diagram of the included participants is presented in **Figure 1**.

The professional background is a relative balance between pharmacists (56.6%) and pharmacy technicians (43.4%). We identified that the median age, working experience, and average working hours were 29 years old (IQR: 9), three years (IQR: 4), and 40 hours per week (IQR: 48). The majority of participants had an educational level at the professional

degree of pharmacist (48.7%) followed by senior high school or equivalent (17.8%) and the rest (33.5%). We assessed that a small proportion of the participants provided drug consultation services in their pharmacies (13.4%). The proportion of participants who conducted drug consultation services was only 13.4%. In terms of TB training, almost half of the participants never had TB training (49.3%). The characteristics of the main study participants can be seen in **Table 1**.

Table 1. Characteristics of the participants (n= 1,129)

No	The characteristics	Number
Socio-demographic characteristics		
1	Female (number, %)	910 (80.6)
2	Age in year (median, IQR)	29 (9)
3	Marital status (number, %)	
	Single	480 (42.5)
	Married	630 (55.8)
	Widow/ widower	19 (1.7)
4	Educational level (number, %)	
	Vocational pharmacy school or equivalent	201 (17.8)
	Diploma	142 (12.6)
	Bachelor	147 (13.0)
	Pharmacist	550 (48.7)
	Master	81 (7.2)
	Doctor	8 (0.7)
5	The number of participant surveyed (number, %)	
	City of Bandung	240 (21.3)
	County of Bandung	285 (25.2)
	City of Makassar	280 (24.8)
	City of Medan	324 (28.7)
Professional characteristics		
4	The professional background (number, %)	
	Pharmacy technicians	490 (43.4)
	Pharmacists	639 (56.6)
7	Working experiences in year (median, IQR)	3 (4)
8	The average of working time in hours per week (median, IQR)	40 (28)
9	The number of practice places (number, %)	
	One pharmacy	987 (87.4)
	Two pharmacies	86 (7.6)
	Three pharmacies	6 (0.5)
	More than three pharmacies	50 (4.4)
10	Providing drug consultation services (number, %)	151 (13.4)
Pharmacy characteristics		
11	Type of pharmacy (number, %)	
	Chain pharmacy	264 (23.4)
	Independent pharmacy	865 (76.6)
12	The availability of physician practice in pharmacy (number, %)	464 (41.1)
TB related characteristics		
13	Experiencing in TB training (number, %)	
	Never	557 (49.3)

	More than two years ago	225 (19.9)
	One-two years ago	191 (16.9)
	Six months - one year ago	90 (8.0)
	Less than sixth months ago	66 (5.8)

Information: IQR: interquartile

TB knowledge

We assessed that most of the TB knowledge items were correctly answered by the participants. However, correct responses concerning TB signs and symptoms, risk population, and TB medication were given by no more than 70% of the participants. The participants inappropriately answered that losing body weight, chest pain, sweat at night, and fever for more than a month are parts of TB symptoms (70.5%). The participants did not know that diabetes mellitus is a risk factor for TB disease (45%). Moreover, although the participants had a pharmaceutical background, they were not familiar with the TB regimen for drug-sensitive TB and how to take the medication, either with or without food. The percentages of participants who correctly answered on the first-line regimen for drug-sensitive TB in the intensive treatment phase; the first-line regimen for drug-sensitive TB in the continuous treatment phase; and the preferable utilisation of the first-line anti-TB drugs on an empty stomach were only 62.4%, 54.5%, and 45.3%, respectively. The proportion of the correct answers in the TB knowledge items is presented in **Table 2**.

Table 2. The items of TB knowledge (n= 1,129)

No	Concept	Items	Correct answer (%)
1	Pathogenesis	Tuberculosis (TB) is caused by virus	70.9
2	TB transmission	TB does not only spread into the lungs but also the other part of bodies, e.g., eyes, joints, and bone	82.1
		TB can spread by droplet from coughing or sneezing of a pulmonary TB patient	97.7
		The droplet containing TB pathogen can stay longer in the room with minimum ventilation	88.5
3	TB sign and symptom	Coughing more than equal two weeks is a general sign of pulmonary TB	82.4
		An active TB patient can cough up blood	95.9
		The general signs of pulmonary TB, i.e., loss of body weight, chest pain, sweat at night, and fever more than a month	29.5
4	Risk population	Diabetes mellitus is a risk factor for having TB	55
		HIV is a risk factor for having TB	84.4
		Children under five years old is a risk group of TB disease	75.6
5	TB diagnosis procedure	A microscopic test of the TB patient's sputum is a diagnostic approach for TB	87.7

		A rapid molecular test of the TB patient's sputum is a diagnostic approach for TB	76.3
6	TB medication and its use	The first line of anti-tuberculosis regimen for the intensive phase	62.4
		The first line of anti-tuberculosis regimen for the continued phase	54.5
		Taking of anti-TB drugs without food	45.3
7	Adverse drug reaction and drug monitoring	Adverse drug reaction of isoniazid	87.2
		Adverse drug reaction of rifampicin	78.2

TB attitude

Most participants believed they have a role (75.1%) and capability (65.4%) to detect TB cases in their pharmacy. The majority of participants also felt guilty if they did not make any effort to detect TB cases (67.4%). On the other hand, 58.2% of participants believed they had significant barriers to finding TB cases in their workplace. It highlighted that most participants realised they face significant barriers to performing TB case detection in their pharmacies. The attitude of the participant is presented in **Table 3.**

Table 3. The items of attitude for TB case detection (n= 1,129)

No	Concept	Items	Percentage (%)				
			Strongly agree	Agree	Doubt	Disagree	Strongly disagree
1	The professional role	I have a role in finding TB cases in my workplace	21	54.1	15.1	9.2	0.6
2	The capability	I can screen TB signs and symptoms for the suspected TB patients who visit my workplace	11.9	53.5	23.1	9.8	1.7
		I feel that there are no significant barriers to finding new TB cases in my workplace	7	33.8	36.6	21.2	1.4
4	The consequence	I feel guilty if I do not make any efforts to find new TB cases in my workplace	21.2	46.2	19.1	20.6	1.8

TB practice

Our study demonstrated that most participants did not always perform the practice in TB case detection. Only a small proportion of the participants routinely conducted TB screening (2%),

suggested the suspected TB patients for further examination (6.6%), and communicated with TB health care providers about referring suspected TB patients (1.8%) every week in the last six months. We assessed that more than 15% of the participants had never performed TB case detection in their pharmacy in the last six months. The remaining participants stated that practising TB case detection was performed once in 2-6 months. The practice of TB case detection in the included participants is shown in **Table 4**.

Table 4. The items of the practice in TB case detection (n= 1,129)

No	Items	Percentage (%)				
		Very often	Often	Some times	Rarely	Never
1	Practice in screening TB signs and symptoms for people who suspected TB	2	10.9	27.1	35.2	24.8
2	Practice in suggesting the suspected TB patients for further health examination to the community health centre or health facility	6.6	26.8	24.4	25.8	16.4
3	Practice in communicating with TB health care providers in referring the suspected TB patient to them	1.8	11.1	16.5	26.5	44.2

Information: Very often: at least every week; often: at least every month; sometimes: at least once 2-4 months; rarely: at least once 5-6 months; never: never doing the activities in the last six months.

Factors associated with TB practice and the exploratory analyses

We included all participant characteristics, TB knowledge, and attitude items in a regression analysis to identify factors associated with practice on TB case detection. Multicollinearity was identified in the factors of education level and professional background. We, therefore, removed the determinant of the level of education in the regression analysis. After it had been removed, the regression assumption was fulfilled since the residual data were normally distributed and no multicollinearity (**Supplementary File 4**)

The regression analysis showed that male gender (Beta coefficient, B= 0.41; *p*-value<0.05), providing drug consultation services (B= 0.68; *p*<0.05), experience in TB training (B= 0.83; *p*<0.00), working hours per week (B= -0.16; *p*<0.05), being a participant from the county of Bandung (B= -0.52; *p*<0.05), and a positive attitude on TB case detection (B= 0.34; *p*<0.00) were significant factors for TB case detection practice. However, although the factor of working hours and being a participant from the county of Bandung were significant factors for TB case detection practice (p< 0.05), the beta coefficients were negative, which means that the factors had negative effects on TB case detection activities. Among the significant factors, we identified that factors related to experiencing TB training (B= 0.83), providing drug consultation

services (B= 0.68), male gender (B= 0.41), and a positive attitude on TB case detection (B= 0.34) were the most influential factors in the practice of TB case detection. The regression analysis of the factors associated with the practice of TB case detection is presented in **Supplementary File 4.**

Assuming TB knowledge and attitude were associated with TB case detection practice, we explored factors associated with TB knowledge and attitude. In terms of TB knowledge, we found that age (B= 0.07; p<0.05), being a pharmacist (B= 2.2; p<0.00), experience in TB training (B= 0.65; p<0.00), and a positive attitude on TB case detection (B= 0.1: p<0.00) were positively associated with TB knowledge. Meanwhile, a factor of being a participant from the county of Bandung (B= -1.04; p<0.00) and city of Makassar (B= -1.13; p<0.00) were negatively associated with TB knowledge as compared with being a participant from the city of Bandung.

Regarding the attitude, the analysis demonstrated that factors positively associated with TB attitude were male gender (B= 0.68; p<0.00), TB knowledge (B=0.74; p<0.00), provision of drug consultation services (B= 0.91; p< 0.00), experience in TB training (B= 0.84; p<0.00), being a participant from the county of Bandung (B= 0.93; p< 0.00) and city of Makassar (B= 0.51; p<0.05). Meanwhile, working in a chain pharmacy (B= -0.64; p<0.00) was negatively associated with TB case detection attitude. The regression analyses on the factors associated with TB knowledge, and attitude, are presented in **Supplementary File 5**.

Generally, our study demonstrated that exposure of TB training is strongly associated with improving TB knowledge (B= 0.64; p< 0.00), attitude (B= 0.84; p< 0.00), and practice (B= 0.83; p< 0.00) in TB case detection.

DISCUSSION

Our study demonstrated that knowledge on TB as a disease was present among pharmacists and pharmacy technicians. However, a minority had incorrect responses on TB knowledge items. Despite their pharmaceutical background, many participants were unfamiliar with the first-line regimen for drug-susceptible TB. As to their attitude, most participants showed a role and capacity to detect TB cases in their pharmacy, but they realised significant barriers in performing TB case detection. In this respect, only a small proportion of participants already performed TB case detection practices in their community pharmacies.

In terms of TB knowledge, our participants showed a high understanding of several topics, such as TB transmission, diagnostic procedures, and potential adverse drug reactions. However, the participants should be strengthened on the knowledge about TB signs and symptoms, risk population, and medication since those knowledge scores are relatively low.

These findings were also reported by a private retail survey in Tanzania that demonstrated the observed participants did not fully understand TB symptoms and the risk factor of TB[27]. Although some items are slightly different across the studies, studies on community pharmacy in Peru[28], Tanzania[27], and Pakistan[29] showed that community pharmacy personnel have the good basic knowledge for TB that support them conducting activities in TB case detection

Practising TB case detection in the pharmacy was associated with experience in TB training, positive attitude, drug consultation services, male gender, short working hours per week, and pharmacies located in central city areas**.** We finally analysed that experience in following TB training is essential for improving TB knowledge, forming a positive attitude, and performing activities on TB case detection. Our study thus emphasises the importance of TB training to gain TB knowledge and a positive attitude. The knowledge and attitude can then generate action for TB case detection. It is in line with the knowledge, attitude, and practice (KAP) theory that states that the changes of human behaviours are divided into three successive processes, i.e., knowledge acquisition, the generation of attitudes, and the formation of behaviours [30]. In the health belief model, knowledge plays a key role in generating action, then belief and attitude drive behaviour change[31].

Next to TB training and a positive attitude, we identified other factors relevant to the TB case detection practice, such as providing drug consultation services, male gender, and short working hours per week are associated with the TB case detection practice. This can be explained considering that the males and pharmacies who provide drug consultation services are identified with a positive attitude. Theoretically, the positive attitude will drive them to the TB case detection practice. Furthermore, we assessed that the long duration of working hours could be related to the high workload of the participants. The result is supported by a KAP study that showed that lack of time is the main problem in managing TB case management among pharmacies in Peru[28]. In line with our finding, a qualitative study in India explored that barriers of community pharmacy for TB case detection are the patient volume and workload[32].

In the geographical aspect, our study revealed that pharmacy personnel in a peripheral city area have fewer practices in TB case detection than the pharmacy personnel in the central city. However, the differences in knowledge and attitude between the areas cannot be analysed clearly. This finding underlines that unidentified factors other than knowledge and attitude may affect the practice of TB case detection in a particular area. A systematic review describes that several factors can affect health care practices, such as guidelines, individual

health care provider, patient, professional interaction, incentive and resources, capacity for organizational change, social, political, and legal factors[33].

This study, however, still has limitations. First, this is a self-reported study that may raise the social desirability bias. In that potential bias, the participants may respond in a socially acceptable way that contradicts the fact. Second, the association between the factors and study outcome cannot be framed in the causality concept since the nature of the cross-sectional study does not consider the time difference between the causal factors and effect. However, several efforts were made to minimize the potential bias and increase this study's validity and reliability. We stated in the questionnaire that the data would be analyzed and presented anonymously. This can minimize social desirability bias since the participant's identity would be unknown. We also used the gatekeepers with a broad network and a list of pharmacies in the study sites for data collection. Hence, we reached a high number of pharmacies and participants that can be generalized into the target population.

Several future directions were drawn from this study. We analyzed that the community pharmacy is a potential facility to increase TB case detection. It considers that most community pharmacy personnel already has certain knowledge and a positive attitude in TB case detection. Moreover, the evidence shows that they are indeed the main facility to seek first aid medication for TB patients[3–8]. The other evidence from India, Pakistan, and Tanzania also supported that community pharmacies can help TB case detection[34–36]. However, a comprehensive strategy is required to follow up this study into the implementation level.

First, further study is needed to comprehensively analyse the local determinants affecting TB cases detection activities, including guideline, patient, professional interaction, incentive, resource, capacity for organizational change, and social, political, and legal factors. A qualitative study may be beneficial to explore in detail voices from the field related to the local determinants and partnership strategies from the relevant stakeholders. The future intervention can then be developed based on the identified local determinants and partnership strategies. Second, TB training in improving the knowledge, attitude and practice should be exposed to the community pharmacy. It is not only for increasing TB awareness about case detection activities but also for minimizing irrational dispense of TB drugs[37] and raising awareness of the other potential role of community pharmacy in TB (e.g., treatment supporter, TB medication counsellor). Third, integrating the role of community pharmacy in TB case management with the National Tuberculosis Program (NTP) is essential to have the same vision and concept in accelerating TB elimination. Finally, technical guidance for performing TB case detection in pharmacy and how the activities can integrate with the NTP should also

be developed to have a successful community pharmacy engagement program, especially in improving TB case detection.

CONCLUSION

Community pharmacies have potential roles in supporting TB case detection considering the current basic available knowledge and positive attitude. Our study explains that TB training is important to gain TB knowledge and a positive attitude in performing TB case detection. The knowledge and attitude can then be essential factors in generating action for TB case detection practices. Further study is needed to comprehensively identify the local determinants and partnership strategies with TB stakeholders for developing effective intervention and implementation of TB case detection in community pharmacies.

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Competing interests

The authors declare no competing interests.

Author contribution

Conception and design of the work: ISP, Kh, MAB, EF; Data acquisition: ISP, Kh, MAB, MNK; Data analysis and interpretation: ISP, EF, RA, REA, RR; Preparing the first draft: ISP; Substantial revised the manuscript: all authors; approval for the final manuscript: all authors

Ethics declarations

This study was approved by the ethics committee of Universitas Sumatera Utara No. 599/KEP/USU/2021. All methods were carried out in accordance with the principle of the declaration of Helsinki.

Data availability statement

Data are available upon reasonable request. The data is managed at the Department of Pharmacology and Clinical Pharmacy, Universitas Padjadjaran under the supervision of Ivan S. Pradipta, PhD.

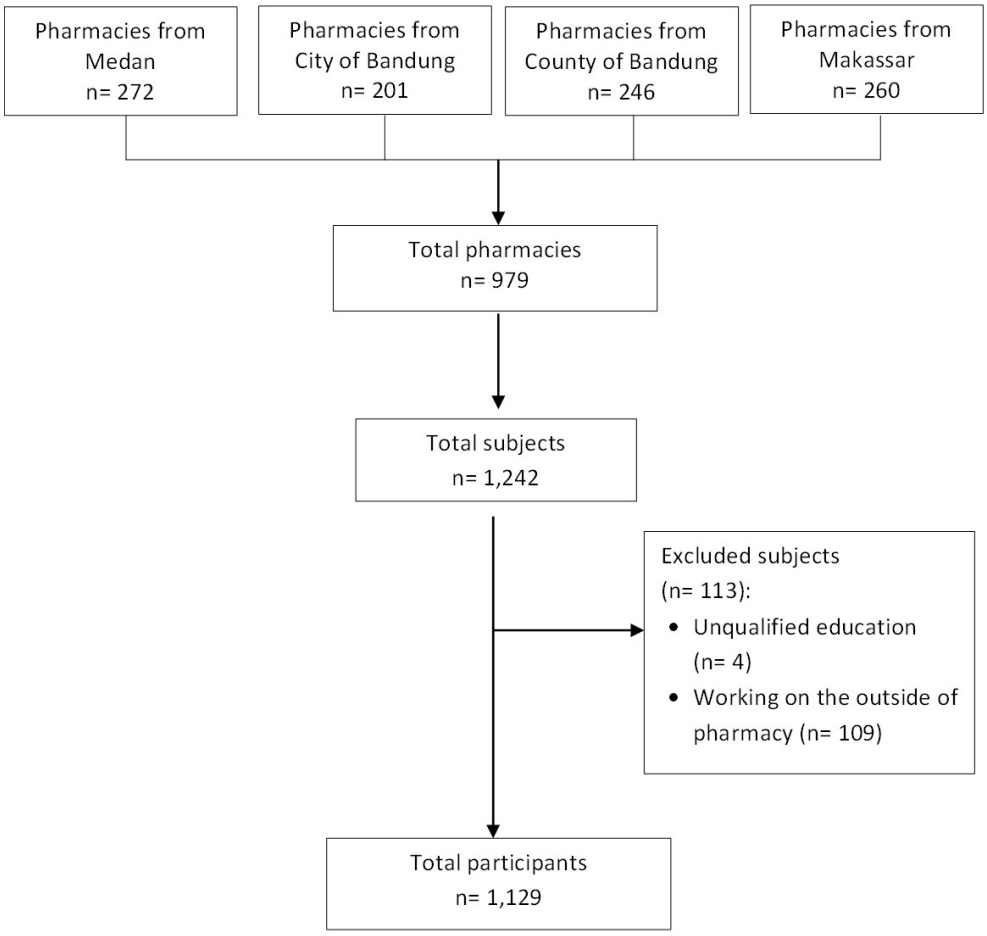

Figure 1. Flow diagram of the included participants

312x297mm (96 x 96 DPI)

SUPPLEMENTARY FILE

Supplementary File 1. Characteristics of the participants in the validity and reliability test (n= 200)

No	The characteristics	Number
1	Female (number, %)	175 (87.5)
2	Marital status (number, %)	
	Single	65 (32.5)
	Married	129 (64.5)
	Widow/ widower	6 (3.0)
3	Type of the professional background (number, %)	
	Pharmacy technicians	49 (24.5)
	Pharmacist	151 (75.5)
4	Educational level (number, %)	
	Senior high school or equivalent	4 (2)
	Diploma	28 (14)
	Bachelor	15 (70.5)
	Pharmacist	141 (70.5)
	Master	12 (6)
	Doctor	0
5	Type of pharmacy (number, %)	
	Chain pharmacy	35 (17.5)
	Independent pharmacy	165 (82.5)
6	The number of practice place (number, %)	
	One pharmacy	173 (86.5)
	Two pharmacies	20 (10)
	Three pharmacies	3 (1.5)
	More than three pharmacies	4 (2)
7	Providing drug consultation services (number, %)	30 (15)
8	Experiencing in TB training (number, %)	
	Never	93 (46.5)
	More than two years ago	47 (23.5)
	One- two years ago	33 (16.5)
	Six months - one year ago	23 (11.5)
	Less than sixth months ago	4 (2)

Supplementary File 2. Validity test of the items (n= 200)

Domain	Items	Coefficient validity (r)
Knowledge	K1	0.439
	K2	0.422
	K3	0.149
	K4	0.172
	K5	0.241
	K6	0.166
	K7	0.611
	K8	0.385
	K9	0.441
	K10	0.259
	K11	0.332
	K12	0.298
	K13	0.530
	K14	0.585
	K15	0.364
	K16	0.512
	K17	0.463
Attitude	A1	0.715
	A2	0.793
	A3	0.661
	A4	0.720
Practice	P1	0.845
	P2	0.884
	P3	0.795

Information: *valid if the coefficient validity is more than 0.13 (coefficient validity reference for 200 participants)

Supplementary File 3. Reliability test of the items (n= 200)

Domain	Cronbach's Alpha
Knowledge	0.63
Attitude	0.69
Practice	0.79

Information: *Reliable if the Cronbach's alpha is more than 0.60

Suplementarry file 4. Regression analysis of the factors associated with the practice of TB case detection among the included participants (n=1,125).

Variable	Beta Coefficient	Standard Error	p-value	95% CI		VIF
				Min.	Max.	
Participant characteristics						
Male gender[¥]	.412	.199	.039	.020	.803	1.049
Married status	.252	.190	.186	-.121	.625	1.494
Age	-.019	.015	.205	-.047	.010	2.381
Professional characteristics						
Pharmacist[$]	-.173	.199	.385	-.562	.217	1.635
Chain pharmacy[¶]	.286	.206	.166	-.119	.690	1.287
Working experience	.020	.018	.256	-.015	.055	1.738
Providing drug information services[#]	.682	.232	.003	.226	1.138	1.056
Availability of medical doctor practice	.221	.167	.184	-.105	.548	1.134
Experience in TB training	.831	.160	.000	.516	1.145	1.085
Working hours per week	-.016	.005	.001	-.026	-.006	1.224
Two practice locations[£]	.295	.295	.319	-.285	.874	1.037
Three practice locations[£]	.125	.372	.738	-.606	.855	1.104
Study sites						
County of Bandung[‡]	-.521	.240	.031	-.992	-.049	1.842
Makassar[‡]	.064	.234	.785	-.395	.522	1.720
Medan[‡]	-.166	.237	.482	-.631	.298	1.936
The Knowledge and Attitude						
TB knowledge	.022	.024	.363	-.025	.068	1.212
TB Attitude	.342	.028	.000	.286	.397	1.101

Information: R^2= 0.20; ß-constanta= 2.27; CI: confidence interval; VIF: variance inflation factor; Reference group= = ¥Female, ¥unmarried status, $assitant pharmacist, ¶Single pharmacy, #No drug consultation service, £one practice location, ‡City of Bandung location

Supplementary File 5. Regression analysis for factors associated with knowledge and attitude of TB case detection (n=1,125).

No	Variables	Knowledge*				Attitude**			
		Beta coeficient	*p*-value	95% CI		Beta coeficient	*p*-value	95% CI	
				Min.	Max.			Min.	Max.
1	Male gender¥$	-.311	0.22	-.805	.182	.677	0.00	.263	1.091
2	Age	.067	0.00	.031	.103	.011	0.47	-.019	.042
3	Married status€	-.220	0.36	-.691	.251	.181	0.37	-.216	.578
4	Pharmacist	2.154	0.00	1.679	2.629	.124	0.56	-.290	.538
5	Chain pharmacy¶	.476	0.06	-.033	.986	-.639	0.00	-1.067	-.210
6	Working experience	-.010	0.66	-.054	.034	-.031	0.10	-.069	.006
7	Working hour per week	-.001	0.84	-.014	.011	-.006	0.26	-.017	.004
8	Providing drug consultation services#	-.158	0.59	-.734	.417	.913	0.00	.432	1.395
9	Experiencing in TB training	.646	0.00	.251	1.041	.836	0.00	.505	1.167
10	Two practice locations£	-.599	0.19	-1.330	.132	.160	0.61	-.456	.777
11	Three or more practice locations£	-.477	0.31	-1.399	.445	-.097	0.81	-.874	.680
12	County of Bandung' site‡	-1.041	0.00	-1.634	-.449	.934	0.00	.436	1.433
13	City of Makassar' site‡	-1.128	0.00	-1.703	-.553	.509	0.04	.023	.996
14	City of Medan' site‡	-.473	0.11	-1.059	.112	.211	0.40	-.282	.705
15	TB knowledge	n.a	n.a	n.a	n.a	.074	0.00	.024	.123
16	Positive attitude in TB case detection	.104	0.00	.034	.173	n.a	n.a	n.a	n.a
17	Availability of medical doctor practice	.305	0.15	-.107	.717	.020	0.91	-.327	.368

Information: *R^2= 0.18; **R^2= 0.09; n.a: not applicable; The reference group= ¥Female, ¥unmarried status, $assitant pharmacist, ¶Single pharmacy, #No drug consultation service, £one practice location, ‡City of Bandung location.

STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Recommendation	Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4
Objectives	3	State specific objectives, including any prespecified hypotheses	4
Methods			
Study design	4	Present key elements of study design early in the paper	5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	5
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6-7
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	6-7
Bias	9	Describe any efforts to address potential sources of bias	15
Study size	10	Explain how the study size was arrived at	6
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	6-7
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	7
		(*b*) Describe any methods used to examine subgroups and interactions	7
		(*c*) Explain how missing data were addressed	7
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	n.a
		(*e*) Describe any sensitivity analyses	n.a
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	8
		(b) Give reasons for non-participation at each stage	8
		(c) Consider use of a flow diagram	Fig.1
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	8 & table. 1
		(b) Indicate number of participants with missing data for each variable of interest	n.a
Outcome data	15*	Report numbers of outcome events or summary measures	Table 2-4

Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	9 & Supl.4 & 5
		(*b*) Report category boundaries when continuous variables were categorized	n.a
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	n.a
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	n.a
Discussion			
Key results	18	Summarise key results with reference to study objectives	13
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	15
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	13-14
Generalisability	21	Discuss the generalisability (external validity) of the study results	15
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	19

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

BMJ Open

Knowledge, Attitude, and Practice of Community Pharmacy Personnel in Tuberculosis Patient Detection: A Multicentre Cross-Sectional Study in a High-Burden Tuberculosis Setting

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Keywords:	Tuberculosis < INFECTIOUS DISEASES, Infection control < INFECTIOUS DISEASES, Public health < INFECTIOUS DISEASES

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Knowledge, Attitude, and Practice of Community Pharmacy Personnel in Tuberculosis Patient Detection: A Multicentre Cross-Sectional Study in a High-Burden Tuberculosis Setting

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ABSTRACT

Introduction: Control of tuberculosis (TB) is hampered by suboptimal case detection and subsequent delays in treatment, which is worsened by the COVID-19 pandemic. The community pharmacy is reported as the place for first aid medication among patients with TB. We, therefore, analysed knowledge, attitude, and practice (KAP) on TB patient detection (TBPD) of community pharmacy personnel, aiming to find innovative strategies to engage community pharmacies in TBPD.

Methods: A multicentre cross-sectional study was performed in four areas of Indonesia's eastern, central and western parts. Pharmacists and pharmacy technicians who worked in community pharmacies were assessed for their characteristics and KAP related to TBPD. Descriptive analysis was used to assess participant characteristics and their KAP, while multivariable regression analyses were used to analyse factors associated with the KAP on TBPD.

Results: A total of 1,129 participants from 979 pharmacies, comprising pharmacists (56.6%) and pharmacy technicians (43.4%), were included. Most participants knew about TB. However, knowledge related to TB symptoms, populations at risk, and medication for TB were still suboptimal. Most participants showed a positive attitude towards TBPD. They believed in their professional role (75.1%), capacity in TB screening (65.4%) and responsibility for TBPD (67.4%). Nevertheless, a lack of TBPD practice was identified in most participants. Several factors significantly associated with performing the TBPD practice ($p< 0.05$), such as TB training experience ($p< 0.001$), provision of a drug consultation service ($p< 0.001$), male gender ($p< 0.05$), a positive attitude towards TBPD ($p< 0.001$), short working hours ($p< 0.001$), and central city location of the pharmacy ($p< 0.05$).

Conclusions: Most participants had good knowledge and attitude, which did not translate into actual TBPD practice. We identified that TB educational programs are essential in improving the KAP. A comprehensive assessment is needed to develop effective strategies to engage the community pharmacy in TBPD activities.

Keywords: pharmacy, KAP, Tuberculosis, Indonesia

Strengths and limitations of this study

- This is the first study that explicitly analyses tuberculosis patient detection knowledge, attitude and practice among pharmacists and pharmacy technicians in community pharmacies in Indonesia.
- A large number of 1,129 participants from 979 pharmacies were included in this study, obtained from Indonesia's western, central, and eastern parts.
- Relevant stakeholders were involved in developing the research question, the study's methodology, and its execution, which helped to assure the quality of the project and provided support for follow-up studies and interventions.
- This was a self-reported study that may have been biased by socially desirable responses.
- No causal relations can be inferred between factors related to patient characteristics, knowledge and attitude on the one hand and TB patient detection practice on the other hand since the nature of the cross-sectional study does not consider the time difference between the causal factors and the effect

INTRODUCTION

Tuberculosis (TB), a disease caused by *Mycobacterium tuberculosis* (M.tb), remains an immense global health problem. The most recent TB report of the World Health Organization (WHO) estimated that its global incidence is about 9.9 million people, with total mortality around 1.3 million people in 2020[1]. The global treatment coverage is still low, with great concern about multi-drug resistant tuberculosis (MDR-TB), i.e., the pathogen's resistance to at least two powerful anti-tuberculosis drugs (isoniazid and rifampicin). Global data showed that the success rate of MDR-TB treatment is only about 59%[1].

The TB problem gets more complex when it is considered that the COVID-19 pandemic affects TB patient detection (TBPD). Globally, TB notifications significantly decreased from 7.1 million (2019) to 5.8 million (2020)[1]. The high-burden TB countries, such as India, Indonesia, Philippines, China, Bangladesh, and Pakistan, contributed most to the global shortfall in TB notification. Indonesia is ranked third amongst the high TB burden countries, with around 824 thousand people who contracted TB in 2020[1]. TB patient notification in Indonesia significantly dropped from 566.8 thousand (2019) to 393.3 thousand (2020) due to the COVID-19 pandemic[1].

The community pharmacy is a potential facility that can help detect TB patients[2]. Studies in high-burden TB countries showed that most TB patients initially present at the pharmacy for their first aid medication[3–8]. However, improper management of TB patients in pharmacies can lead to delayed diagnosis and inappropriate treatment[9,10]. A study in Indonesia estimated that the total delay is caused by various reasons, including visiting a pharmacy for the initial aid medication[3]. A qualitative study also showed that delayed TB diagnosis occurred when the TB patient received inappropriate treatment recommendations from a pharmacy[11]. Improper TB patient management in the pharmacy might be due to poor TB knowledge, attitude, and practices of the pharmacy personnel. All this information suggests that improving TB care in the community pharmacy is needed to enhance the practice of TB screening and refer a presumptive TB patient to the health care facility to support TBPD.

However, there is still limited or no systematic and comprehensive guidance on the involvement of pharmacies in TBPD, including in Indonesia. As a base for such guidance, a first study is needed to analyse the current situation and determinants for practising TBPD among community pharmacies. Therefore, we conducted a multicentre cross-sectional study to analyse the characteristics, knowledge, attitude, and practice (KAP) of the pharmaceutical personnel in the community pharmacy regarding TBPD in Indonesia. To the best of our knowledge, this is the first study on this topic for the setting, and it will be beneficial to develop innovative strategies to increase TBPD in Indonesia and other high-burden TB countries.

METHODS

Study design and setting

A cross-sectional study was performed in four areas in Indonesia's western, central, and eastern parts. The three areas are the capital of provinces, while one area is a peripheral area outside the province capital. Thus, four areas were defined as the study location, i.e., Makassar, Medan, the city of Bandung, and the county of Bandung. Makassar is the capital of South Sulawesi, located in the eastern part of Indonesia, with a population of 2,847,754 persons[12], while Medan is the capital of North Sumatera, located in the western part of Indonesia with 2,681,830 inhabitants[12]. In the central part, the city of Bandung, West Java's capital, was selected as the study setting with a total population of 2,510,103 persons[12]. In addition, the county of Bandung, with a total population of 3,831,505[12], located around 50 kilometres from the city of Bandung, was included as a representation of the peripheral area in this study.

In Indonesia, a pharmacy called *apotek* is a community pharmacy managed by the private sector. It can be a chain pharmacy or an independent pharmacy. According to the national regulation, a pharmacy is a facility where a pharmacist performs pharmaceutical practices in the community[13]. Hence, a pharmacy must be under the authority of a pharmacist who holds a professional degree in pharmacy and a pharmaceutical license from the Ministry of Health, Republic of Indonesia. One or more pharmacy technicians support a responsible pharmacist in a pharmacy. A pharmacy technician should hold a pharmaceutical practice license from the government and have a formal pharmaceutical education, at least in the pharmaceutical vocational school, equivalent to a senior high school education level[13].

Questionnaire development and validation

A validated questionnaire was developed as the instrument for data collection. The questionnaire was developed based on the guideline for knowledge, attitude, and practice survey in TB published by the WHO[14], the practice of survey research[15], the Indonesian national TB guideline[16], experts' consensus on the psychological factors for implementing evidence-based practices[17], and previous relevant studies[18–20].

We defined four assessment domains, i.e., the participant's characteristics, knowledge, attitude, and practice in TBPD. The domain for participant characteristics consisted of age, marital status, professional background, educational level, study site, working experience, an average of working hours per week, type of pharmacy (chain/ independent pharmacy), number of pharmacies for the pharmaceutical practice, availability of a physician practice in the pharmacy, providing drug consultation services, and experience in TB training.

We assessed TB knowledge related to activities in TB detection, i.e., TB pathogen, transmission, symptoms, risk population, diagnosis, and medication. Given the experts' consensus on the essential psychological determinants for implementing evidence based practice[17], the attitude domain was operationalised as the beliefs in the professional role, capability, and consequences of the activities for TBPD. Finally, we defined practices of TBPD as the activities in the screening of TB signs and symptoms, communicating with TB health care workers, and referring a presumptive TB patient to the health facility for further examination in the past six months.

The participant's characteristics domain items were assessed using closed and short open questions, while the item of knowledge domain was measured on a nominal scale ('true', 'false', and 'do not know'). Five Likert scales were used for the attitude, while rating scales were used for practice domain items. We used "strongly agree", "agree", "doubt", "disagree", and "strongly disagree" for the attitude items, and "very often", "often", "sometimes", "rarely", and "never" for the frequency of practice items. The TBPD practice was evaluated over the past six months. The six months were based upon the results of our previous qualitative studies that there was the pharmacy personnel who provided the TBPD practice at least once six months[11,21]. To have a clear definition and comprehensive duration assessment, we defined "very often" as the practice performed at least every week; "often" is the practice performed at least once a month; "sometimes" is the practice performed at least once in 2-4 months; "rarely" is the practice performed once in 5-6 months; and "never" is never doing the practice in the last six months.

We assigned the questionnaire for face and content validation to experts with several backgrounds, i.e., an epidemiologist, a pharmacist, an assistant pharmacist, and a TB specialist. In light of the expert judgments, ISP (TB researcher) and EF (statistician and item developer) finalised the items. A pilot study involving 200 participants who were different from the participants was conducted for the validity and reliability test of the instrument.

Study Size, Participant, and Data Collection

We included participants who had an educational background as a pharmacist or a pharmacy technician; were working as pharmaceutical workers at the community pharmacy; and had experience in the pharmacy for at least six months. The six-month experience was defined considering that the study captured TBPD activities in the last six months. We excluded participants if they worked outside the pharmacy (e.g., in a community health centre or hospital) or were underqualified according to the national regulation.

We used pharmacies as the unit sample in this study. An estimated 1,800 pharmacies in all the study sites were defined as the sample frame, considering the government and

professional organisation data[22]. The study used an online Raosoft® sample size estimator to identify a minimum sample size [23]. In view of a 5% of margin error, 95% confidence level, and 50% response distribution, we identified a total of 317 pharmacies as the minimum sample size in this study.

Data were obtained from July to October 2021. Considering that pharmacists and pharmacy technicians operate pharmacies, two responsible persons for data collection were appointed in each study site, i.e. a data collector for the pharmacists and one for the pharmacy technicians. We collaborated with the two local professional organisations for data collection. The responsible data collector identified and distributed the questionnaire to the potential participants based on the participant eligibility, database, networking, and geographical distribution at the district level. In light of the pandemic COVID-19 situation, we distributed the questionnaire using online and offline approaches. All the collected data were managed and analysed for eligibility of the data and achievement of the sample size by the researchers at each study site (ISP, Kh, MAB, MNK).

Data analysis

In the pilot study, we tested the item validity using a correlation between the score of each item and the total score. A correlation between items was defined if the *p*-value of the Pearson correlation coefficient (r) was below 0.05[24].The reliability test was conducted by identifying Cronbach's alpha, which should be more than 0.60 for an acceptably reliable item[25,26].

Descriptive statistics were used to analyse the characteristics of participants. Categorical data were described as numbers and percentages. Median and interquartile ranges (IQR) were used for continuous and non-normally distributed data. As to the knowledge domain, percentages of participants who had correct answers per item were reported, while in the attitude and practice domain, percentages referred to participants who chose a particular scale in the items.

We performed a multivariable regression analysis to identify factors associated with the practice of TBPD. The normality of the residual was identified by assessing the shape of the residual histogram and the probability-probability (P-P) plot. Multicollinearity was evaluated by identifying the variance inflation factor (VIF) less than 5[27]. Sub-group analysis was performed to analyse a variable from the multivariable analysis deeper. We used logistic regression analysis in the sub-group analysis when the outcome was binary data, while linear regression analysis was used when the outcome data was numeric. We analysed risk groups for poor TB knowledge and attitude as dependent variables. All significance levels were set at 5%, and 95% confidence intervals (CI) were presented. Data management and analysis were performed anonymously, and the analyses were conducted using SPSS version 26.

An unpublished protocol was developed prior to the study to provide better study planning and guidance for the research team. The strengthening of the reporting of observational studies in epidemiology (STROBE) guideline for a cross-sectional study was followed to achieve systematic and transparent study reporting[28].

Patient and Public Involvement

The research question was developed considering the previous interviews and focus group discussions involving TB patients, a non-governmental organization, health service providers, and pharmacists. We involved the representation of professional organizations in pharmacy for data collection.

RESULTS

Questionnaire development and validation

In the phase of questionnaire development, all experts agreed that all items could be used for the research instrument. All items fulfilled the face and content validity with minor structural and content revisions. A total of 40 items were developed to assess participant characteristics (16), knowledge (17), attitude (4), and practice (3). After being revised, we distributed the items to 200 participants for the validity and reliability test.

The knowledge, attitude, and practice items were significantly correlated with each total item (*p*-value< 0.05). Similarly, all the knowledge, attitude, and practice items were reliable since Cronbach's alpha ranged from 0.63 to 0.79. The participants' characteristics, validity, and reliability test in the pilot study can be seen in **Supplementary files 1, 2**, and **3**, respectively.

Study Size and Participant Characteristics

We successfully collected data from 979 pharmacies with 1,242 subjects, from much more than the 317 pharmacies defined as the minimum sample size. However, we excluded 113 subjects due to an under-qualified education level (4) and working outside of the community pharmacy (109). Finally, we included 1,129 participants for further data analysis. We identified that the participant backgrounds were relative balance, i.e. 56.6 % were pharmacists, and 43.6% were pharmacy technicians. The flow diagram of the included participants is presented in **Figure 1**.

We identified that the median age, working experience, and average working hours were 29 years old (IQR: 9), three years (IQR: 4), and 40 hours per week (IQR: 48), respectively. The majority of participants had an educational level at the professional degree of pharmacist

(48.7%) followed by senior high school or equivalent (17.8%) and the rest (33.5%). We assessed that only a small proportion of participants provided drug consultation services in their pharmacies (13.4%). In terms of TB training, almost half of the participants never had TB training (49.3%). The characteristics of the main study participants can be seen in **Table 1**.

Table 1. Characteristics of the study participants (n= 1,129)

No	Characteristics	Number
Socio-demographic characteristics		
1	Female (number, %)	910 (80.6)
2	Age in year (median, IQR)	29 (9)
3	Marital status (number, %)	
	Single	480 (42.5)
	Married	630 (55.8)
	Widow/ widower	19 (1.7)
4	Educational level (number, %)	
	Vocational pharmacy school or equivalent	201 (17.8)
	Diploma	142 (12.6)
	Bachelor	147 (13.0)
	Pharmacist	550 (48.7)
	Master	81 (7.2)
	Doctor	8 (0.7)
5	Number of participants surveyed (number, %)	
	City of Bandung	240 (21.3)
	County of Bandung	285 (25.2)
	City of Makassar	280 (24.8)
	City of Medan	324 (28.7)
Professional characteristics		
4	Professional background (number, %)	
	Pharmacy technicians	490 (43.4)
	Pharmacists	639 (56.6)
7	Working experience in years (median, IQR)	3 (4)
8	Average working time in hours per week (median, IQR)	40 (28)
9	Number of practice places (number, %)	
	One pharmacy	987 (87.4)
	Two pharmacies	86 (7.6)
	Three pharmacies	6 (0.5)
	More than three pharmacies	50 (4.4)
10	Providing drug consultation services (number, %)	151 (13.4)
Pharmacy characteristics		
11	Type of pharmacy (number, %)	
	Chain pharmacy	264 (23.4)
	Independent pharmacy	865 (76.6)
12	Availability of a physician practice in the pharmacy (number, %)	464 (41.1)
TB related characteristics		
13	Experience in TB training (number, %)	
	Never	557 (49.3)
	More than two years ago	225 (19.9)
	One-two years ago	191 (16.9)
	Six months - one year ago	90 (8.0)
	Less than six months ago	66 (5.8)

Information: IQR: interquartile

Knowledge of pharmacy personnel on Tuberculosis

We assessed that most of the TB knowledge items were correctly answered by the participants. However, correct responses concerning TB signs and symptoms, risk population, and TB medication were given by no more than 70% of the participants. The participants inappropriately answered about general signs of pulmonary TB (70.5%). The participants did not know that diabetes mellitus is a risk factor for TB disease (45%). Moreover, although the participants had a pharmaceutical background, they were not familiar with the TB treatment regimen for drug-sensitive TB and how to take the medication, either with or without food. The percentages of participants who correctly answered on the first-line regimen for drug-sensitive TB in the intensive treatment phase; the first-line regimen for drug-sensitive TB in the continuous treatment phase; and the preferable utilisation of the first-line anti-TB drugs on an empty stomach were only 62.4%, 54.5%, and 45.3%, respectively. The proportion of the correct answers in the TB knowledge items is presented in **Table 2**.

Table 2. The items of TB knowledge (n= 1,129)

No	Concept	Items	Correct answer (%)
1	The pathogen	Tuberculosis (TB) is caused by virus	70.9
2	TB transmission	TB does not only spread into the lungs but also to other parts of the body, e.g., eyes, joints, and bone	82.1
		TB can spread by droplets from coughing or sneezing of a pulmonary TB patient	97.7
		The droplet containing the TB pathogen can stay longer in a room with minimum ventilation	88.5
3	TB sign and symptom	Coughing for more than equal two weeks is a general sign of pulmonary TB	82.4
		An active TB patient can cough up blood	95.9
		The general signs of pulmonary TB, i.e., loss of body weight, chest pain, sweat at night, and fever for more than a month	29.5
4	Risk population	Diabetes mellitus is a risk factor for having TB	55
		HIV infection is a risk factor for having TB	84.4
		Children under five years old is a risk group for TB disease	75.6
5	TB diagnosis procedure	A microscopic test of the TB patient's sputum is a diagnostic approach for TB	87.7
		A rapid molecular test of the TB patient's sputum is a diagnostic approach for TB	76.3
6	TB medication and its use	The first line anti-tuberculosis regimen for the intensive phase	62.4
		The first line anti-tuberculosis regimen for the continued phase	54.5

		Taking anti-TB drugs without food	45.3
7	Adverse drug reaction and drug monitoring	Adverse drug reactions of isoniazid	87.2
		Adverse drug reactions of rifampicin	78.2

The Attitude of Pharmacy Personnel toward Tuberculosis Patient Detection

Most participants believed they had a role (75.1%) and capability (65.4%) to detect TB patients in their pharmacy. The majority of participants also felt guilty if they did not make any effort to detect TB patients (67.4%). On the other hand, 58.2% of participants believed they had significant barriers to finding TB patients in their workplace. It highlighted that most participants realised they faced significant barriers to performing TBPD in their pharmacies. The attitude of the participant is presented in **Table 3.**

Table 3. The items of attitude for TB patient detection (n= 1,129)

No	Concept	Items	Percentage (%)				
			Strongly agree	Agree	Doubt	Disagree	Strongly disagree
1	The professional role	I have a role in finding TB patients in my workplace	21	54.1	15.1	9.2	0.6
2	The capability	I can screen TB signs and symptoms for presumptive TB patients who visit my workplace	11.9	53.5	23.1	9.8	1.7
		I feel that there are no significant barriers to finding new TB patients in my workplace	7	33.8	36.6	21.2	1.4
3	The consequence	I feel guilty if I do not make any efforts to find new TB patients in my workplace	21.2	46.2	19.1	20.6	1.8

The Practice of Pharmacy Personnel toward Tuberculosis Patient Detection

Our study demonstrated that most participants did not always perform practice in TBPD. Only a small proportion of the participants routinely conducted TB screening (2%), suggested presumptive TB patients for further examination (6.6%), and communicated with TB health care providers about referring presumptive TB patients (1.8%) every week in the last six months. We assessed that more than 15% of the participants had never performed TBPD in

their pharmacy in the last six months. The remaining participants stated that practising TBPD was performed once every 2-6 months. The practice of TBPD in the included participants is shown in **Table 4**.

Table 4. The items of the practice in TB patient detection (n= 1,129)

No	Items	Percentage (%)				
		Very often	Often	Some times	Rarely	Never
1	Practise in screening TB signs and symptoms for the presumptive TB patient	2	10.9	27.1	35.2	24.8
2	Practice in suggesting presumptive TB patients for further health examination to the community health centre or health facility	6.6	26.8	24.4	25.8	16.4
3	Practise communicating with TB health care providers in referring the presumptive TB patient to them	1.8	11.1	16.5	26.5	44.2

Information: Very often: at least every week; often: at least every month; sometimes: at least once 2-4 months; rarely: at least once 5-6 months; never: never doing the activities in the last six months.

Factors associated with TB practice and the exploratory analyses

We included all participant characteristics, TB knowledge, and attitude items in a regression analysis to identify factors associated with the practice of TBPD. Multicollinearity was identified in the factors of education level and professional background. We, therefore, removed the determinant of the level of education in the regression analysis. After it had been removed, the regression assumption was fulfilled since the residual data were normally distributed and no multicollinearity occurred (**Supplementary File 4**)

The regression analysis showed that male gender (Beta coefficient, B= 0.41; *p*-value<0.05; 95% confidence interval, CI= 0.02– 0.80), providing drug consultation services (B= 0.68; *p*<0.05; 95%CI= 0.23– 1.14), experience in TB training (B= 0.83; *p*<0.001; 95%CI= 0.52–1.15), working hours per week (B= -0.16; *p*<0.05; 95%CI= -0.03– -0.01), being a participant from the county of Bandung (B= -0.52; *p*<0.05; 95%CI= -0.99– -0.05), and a positive attitude on TBPD (B= 0.34; *p*<.001; 95%CI= 0.29– 0.40) were significant factors for TBPD practice. Of note, the beta coefficients were negative for the factor of working hours and for being a participant from the county of Bandung, which means that the factors had negative effects on TBPD activities. A higher beta coefficient represented the more influential factors. To have a comprehensive picture of the association between gender and TBPD practice, we conducted a sub-group analysis of the gender variable. The sub-group analysis showed that age, providing drug consultation services, and positive attitude towards TBPD were

associated with the male gender. The multivariable regression analysis of the factors associated with the practice of TBPD and the gender analysis are presented in **Supplementary Files 4 and 5.**

Assuming TB knowledge and attitude were associated with TBPD practice, we explored factors associated with TB knowledge and attitude. In terms of TB knowledge, we found that age (B= 0.07; *p*< 0.05; 95%CI= 0.03— 0.10), being a pharmacist (B= 2.2; *p*< 0.001; 95%CI= 1.68— 2.63), experience in TB training (B= 0.65; *p*< 0.001; 95%CI= 0.25— 1.04), and a positive attitude on TBPD (B= 0.1: *p*< 0.001; 95%CI= 0.03— 0.17) were positively associated with TB knowledge. Meanwhile, the factors of being a participant from the county of Bandung (B= -1.04; *p*< 0.001; 95%CI= -1.63— -0.45) and from the city of Makassar (B= -1.13; *p*< 0.001; 95%CI= -1.70— -0.55) were negatively associated with TB knowledge as compared with being a participant from the city of Bandung.

Regarding the attitude, the analysis demonstrated that factors positively associated with TB attitude were male gender (B= 0.68; *p*< 0.001; 95%CI= 0.26— 1.09), TB knowledge (B=0.74; *p*< 0.001; 95%CI= 0.02— 0.12), provision of drug consultation services (B= 0.91; *p*< 0.001; 95%CI= 1.40— 0.68), experience in TB training (B= 0.84; *p*< 0.001; 95%CI= 0.51— 1.16), being a participant from the county of Bandung (B= 0.93; *p*< 0.001; 95%CI= 0.44— 1.43) and city of Makassar (B= 0.51; *p*< 0.05; 95%CI= 0.02— 0.99). Meanwhile, working in a chain pharmacy (B= -0.64; *p*< 0.001; 95%CI= -1.07— -0.21) was negatively associated with TBPD attitude. The regression analyses on the factors associated with TB knowledge, and attitude, are presented in **Supplementary File 4**.

Generally, our study demonstrated that exposure to TB training is strongly associated with improving TB knowledge (B= 0.65; *p*< 0.001; 95%CI= 0.25— 1.04), attitude (B= 0.84; *p*< 0.001; 95%CI= 0.51— 1.16), and practice (B= 0.83; *p*< 0.001; 95%CI= 0.52— 1.15) in TBPD.

DISCUSSION

Our study demonstrated that knowledge of TB as a disease was present among pharmacists and pharmacy technicians. However, a minority had incorrect responses on TB knowledge items. Despite their pharmaceutical background, many participants were unfamiliar with the first-line treatment regimen for drug-susceptible TB. As to their attitude, most participants showed a role and capacity to detect TB patients in their pharmacy, but they realised significant barriers in performing TBPD. In this respect, only a small proportion of participants already performed TBPD practices in their community pharmacies.

In terms of TB knowledge, our participants showed a high understanding of several topics, such as TB transmission, diagnostic procedures, and potential adverse drug reactions. However, the participants should be strengthened in their knowledge about TB signs and symptoms, risk population, and medication since those knowledge scores were relatively low. Good knowledge was associated with participants who have a pharmacist background. This finding highlights the importance of exposing TB knowledge to the pharmacy technicians since they also have a role as the frontline in pharmacy. Unintegrated pharmaceutical services in TB programs and a lack of public-private collaboration with community pharmacies were reported in Indonesia.[11,21] This potentially leads to the limited exposure of community pharmacy personnel to the educational program from the national TB programme.

Insufficient TB knowledge was also reported by a private retail survey in Tanzania that demonstrated that the observed participants did not fully understand TB symptoms and the risk factors of TB[29]. Although some items are slightly different across the studies, studies on community pharmacies in Peru[30], Tanzania[29], and Pakistan[20] showed that community pharmacy personnel has the basic knowledge of TB that can support them in conducting activities in TBPD.

Practising TBPD in the pharmacy was associated with experience in TB training, a positive attitude towards TBPD, provision of drug consultation services, male gender, short working hours per week, and pharmacies located in central city areas**.** We finally found that experience in following TB training is essential for improving TB knowledge, forming a positive attitude, and performing activities on TBPD. Our study thus emphasises the importance of TB training to gain TB knowledge and a positive attitude. The knowledge and attitude can then generate action for TBPD. It is in line with the knowledge, attitude, and practice (KAP) theory that states that the changes in human behaviour are divided into three successive processes, i.e., knowledge acquisition, the generation of attitudes, and the formation of behaviour [31]. In the health belief model, knowledge plays a key role in generating action, and then belief and attitude drive behaviour change[32].

Next to TB training and a positive attitude, we identified other factors relevant to the TBPD practice, such as male gender and providing drug consultation services. We identified that the proportion of females (80.6%) is higher than males (19.4%) in our study. It is in line with national data showing that females represent the majority of pharmaceutical personnel in Indonesia (80.6%)[33]. Although the proportion of females is higher than males, our study identified that males are more likely to perform TBPD practices. Our sub-group analysis explained that males have a more positive attitude towards TBPD and provide more drug consultation services than females (See **Supplementary File 5)**. The positive attitude may drive them to provide the drug consultation service and lead them to perform TBPD activities

as well. It can be explained that providing drug consultation services will give them more opportunities to meet patients directly, leading to the TBPD activities. However, further study is needed to have a more comprehensive picture of the associations that include other relevant variables.

Furthermore, we assessed that time available to perform TBPD activities is essential. Our study emphasised the need for workload assessment for the community pharmacies to be able to conduct TBPD activities. This conclusion is supported by a KAP study in Peru that showed that lack of time is the main problem in managing TB patient management among pharmacies[30]. Supporting our findings, studies in India and Indonesia identified that patient volume and workload are the barriers to performing TBPD activities and pharmaceutical services in community pharmacies[34,35].

In the geographical aspect, our study revealed that pharmacy personnel in a peripheral city area has fewer TBPD practices than the pharmacy personnel in the central city. However, the differences in knowledge and attitude between the areas cannot be analysed clearly. This finding underlines that unidentified factors other than knowledge and attitude may affect the practice of TBPD in a particular area. A systematic review describes that several factors can affect health care practices, such as guidelines, individual healthcare providers, patients, professional interaction, incentives and resources, capacity for organizational change, social, political, and legal factors[36]. Hence, a comprehensive analysis may be beneficial to analyse the geographical effect on the TBPD activities.

This study, however, has limitations. First, this is a self-reported study that may be biased by social desirability. This means that participants may respond in a socially acceptable way that contradicts the facts. Second, formally no causal relations can be inferred between factors related to patient characteristics, knowledge, and attitude on the one hand and TBPD practice on the other hand since the nature of a cross-sectional study does not consider the time difference between the causal factors and the eventual effect. However, several efforts were made to minimize potential bias and increase this study's validity and reliability. We stated in the questionnaire that data would be analysed and presented anonymously. This can minimize social desirability bias since the participant's identity would be unknown. We also collaborated with professional organizations that have a broad network and a list of pharmacies in the study sites for data collection. Hence, we reached a high number of pharmacies and participants that could be considered highly representative of the target population.

We analysed that the community pharmacy is a potential facility to increase TBPD. It considers that most community pharmacy personnel already has certain basic knowledge and a positive attitude toward TBPD. Moreover, the evidence shows that they are indeed the main facility to

seek first aid medication for TB patients[3–8]. Other evidence from India, Pakistan, and Tanzania also supported that community pharmacies can help in detecting TB patients in the community[37–39]. However, a comprehensive strategy is required to follow up on this study to implement TBPD activities among pharmacy personnel.

First, further study is needed to comprehensively analyse the local determinants affecting TBPD activities, including guidelines, patients, professional interactions, incentives, resources, capacity for organizational change, and social, political, and legal factors. A qualitative study may be beneficial to explore in detail voices from the field related to the local determinants and partnership strategies from the relevant stakeholders. A future intervention can then be developed based on the identified local determinants and partnership strategies. Second, a TB training system for improving the KAP should be developed for pharmacy personnel. The training is not only for increasing TB awareness about case detection activities but also for minimising irrational dispense of TB drugs[40] and raising awareness on the other potential roles of community pharmacy in TB (e.g., treatment supporter, TB medication counsellor). As a treatment supporter, pharmacy personnel can potentially reduce the clinical and economic impacts of TB medication adherence[41–43]. Third, integrating the role of community pharmacy in TB patient management within National Tuberculosis Programs (NTPs) is essential to have the same vision and concept in accelerating TB elimination. Finally, technical guidance for performing TBPD in pharmacies and integrating the activities in NTPs should also be developed to have a successful community pharmacy engagement program, especially in TBPD activities.

CONCLUSION

Our study showed that most Indonesian pharmacists and pharmacy technicians have a good knowledge and attitude related to TBPD. However, their knowledge and attitude do not align with their actual TBPD practice. We identified that a TB educational program is essential in improving KAP among pharmacy personnel for TBPD activities. A systematic and comprehensive assessment is needed to develop an effective strategy for engaging the community pharmacy in sustainable TBPD activities.

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Competing interests

The authors declare no competing interests.

Author contribution

Main idea: ISP; Conception and design of the work: ISP, Kh, MAB, EF; Data acquisition: ISP, Kh, MAB, MNK; Data analysis and interpretation: ISP, EF, RA, REA, RR; Preparing the first draft: ISP; Substantial revision of the manuscript: all authors; approval for the final manuscript: all authors

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Ethics declarations

This study was approved by the ethics committee of Universitas Sumatera Utara No. 599/KEP/USU/2021. All methods were carried out in accordance with the principles of the declaration of Helsinki.

Data availability statement

Data are available upon reasonable request. The data were managed at the Department of Pharmacology and Clinical Pharmacy, Universitas Padjadjaran, under the supervision of Ivan S. Pradipta, PhD.

Figure Legends.

Figure 1. The flow diagram of the included participants

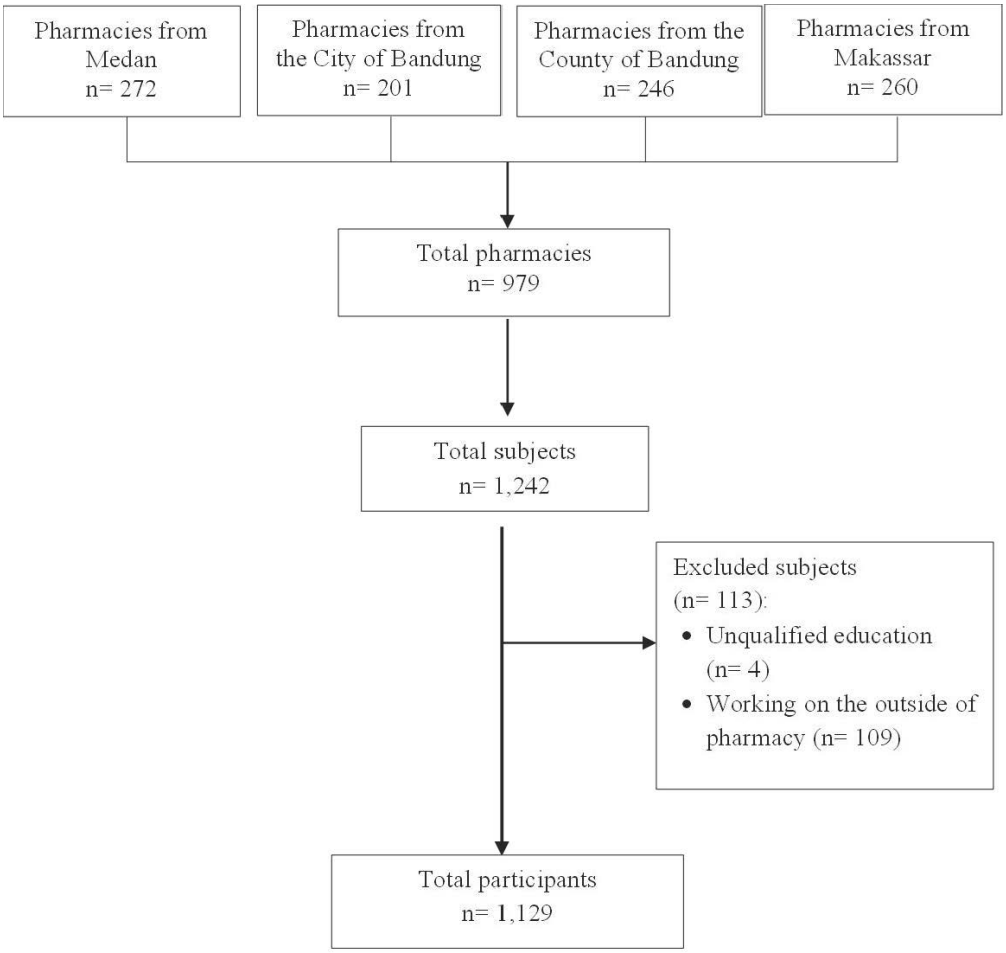

Figure 1. The flow diagram of the included participants

306x290mm (96 x 96 DPI)

SUPPLEMENTARY FILE

Supplementary File 1. Characteristics of the study participants in the validity and reliability test(n= 200)

No	The characteristics	Number
1	Female (number, %)	175 (87.50)
2	Marital status (number, %)	
	Single	65 (32.50)
	Married	129 (64.50)
	Widow/ widower	6 (3.0)
3	Type of the professional background (number, %)	
	Pharmacy technicians	49 (24.50)
	Pharmacist	151 (75.50)
4	Educational level (number, %)	
	Senior high school or equivalent	4 (2)
	Diploma	28 (14)
	Bachelor	15 (70.50)
	Pharmacist	141 (70.50)
	Master	12 (6)
	Doctor	0
5	Type of pharmacy (number, %)	
	Chain pharmacy	35 (17.50)
	Independent pharmacy	165 (82.50)
6	The number of practice place (number, %)	
	One pharmacy	173 (86.50)
	Two pharmacies	20 (10)
	Three pharmacies	3 (1.50)
	More than three pharmacies	4 (2)
7	Providing drug consultation services (number, %)	30 (15)
8	Experiencing in TB training (number, %)	
	Never	93 (46.50)
	More than two years ago	47 (23.50)
	One- two years ago	33 (16.50)
	Six months - one year ago	23 (11.50)
	Less than six months ago	4 (2)

Supplementary File 2. Item correlation with Pearson test (n= 200)

Domain	Items	Coefficient validity (r)	p-value
Knowledge	K1	0.439	0.00
	K2	0.422	0.00
	K3	0.149	0.04
	K4	0.172	0.02
	K5	0.241	0.00
	K6	0.166	0.02
	K7	0.611	0.00
	K8	0.385	0.00
	K9	0.441	0.00
	K10	0.259	0.00
	K11	0.332	0.00
	K12	0.298	0.00
	K13	0.530	0.00
	K14	0.585	0.00
	K15	0.364	0.00
	K16	0.512	0.00
	K17	0.463	0.00
Attitude	A1	0.715	0.00
	A2	0.793	0.00
	A3	0.661	0.00
	A4	0.720	0.00
Practice	P1	0.845	0.00
	P2	0.884	0.00
	P3	0.795	0.00

Supplementary File 3. Reliability test of the items (n= 200)

Domain	Cronbach's Alpha
Knowledge	0.63
Attitude	0.69
Practice	0.79

Information: *Reliable if the Cronbach's alpha is more than 0.60

Supplementary File 4. The multivariable linear regression analysis for factors associated with knowledge, attitude and practice of TBPD (n=1,125).

No	Variables	Knowledge*				Attitude**				Practice***			
		B	*p*-value	95% CI		B	*p*-value	95% CI		B	*p*-value	95% CI	
				Min.	Max.			Min.	Max.			Min.	Max.
1	Male gender[¥$]	-0.31	0.22	-0.81	0.18	0.68	0.00	0.26	1.09	0.41	.039	0.02	0.80
2	Age	0.07	0.00	0.03	0.10	0.01	0.47	-0.02	0.04	-0.02	.205	-0.05	0.01
3	Married status[€]	-0.22	0.36	-0.69	0.25	0.18	0.37	-0.22	0.58	0.25	.186	-0.12	0.63
4	Pharmacist	2.15	0.00	1.68	2.63	0.12	0.56	-0.29	0.54	-0.17	.385	-0.56	0.22
5	Chain pharmacy[¶]	0.48	0.06	-0.03	0.99	-0.64	0.00	-1.07	-0.21	0.29	.166	-0.12	0.69
6	Working experience	-0.01	0.66	-0.05	0.03	-0.03	0.10	-0.07	0.01	0.02	.256	-0.02	0.06
7	Working hour per week	-0.00	0.84	-0.01	0.01	-0.01	0.26	-0.02	0.00	-0.16	.001	-0.03	-0.01
8	Providing drug consultation services[#]	-0.16	0.59	-0.73	0.42	0.91	0.00	0.43	1.40	0.68	.003	0.23	1.14
9	Experiencing TB training	0.65	0.00	0.25	1.04	0.84	0.00	0.51	1.16	0.83	.000	0.52	1.15
10	Two practice locations[£]	-0.60	0.19	-1.33	0.13	0.16	0.61	-0.46	0.78	0.30	.319	-0.29	0.87
11	Three or more practice locations[£]	-0.48	0.31	-1.40	0.45	-0.10	0.81	-0.87	0.68	0.13	.738	-0.61	0.86
12	County of Bandung' site[‡]	-1.04	0.00	-1.63	-0.45	0.93	0.00	0.44	1.43	-0.52	.031	-0.99	-0.05
13	City of Makassar' site[‡]	-1.13	0.00	-1.70	-0.55	0.51	0.04	0.02	0.99	0.06	.785	-0.40	0.52
14	City of Medan' site[‡]	-0.47	0.11	-1.06	0.11	0.21	0.40	-0.28	0.71	-0.17	.482	-0.63	0.30
15	TB knowledge	n.a	n.a	n.a	n.a	0.07	0.00	0.02	0.12	0.02	.363	-0.03	0.07
16	Positive attitude in TB case detection	0.10	0.00	0.03	0.17	n.a	n.a	n.a	n.a	0.34	.000	0.29	0.40
17	Availability of medical doctor practice	0.31	0.15	-0.11	0.72	0.02	0.91	-0.33	0.37	0.22	.184	-0.11	0.55

Information: *R^2= 0.18; **R^2= 0.09; ***R^2= 0,2; B= Beta coefficient; CI: confidence interval; Min: Minimum; Max: maximum; n.a: not applicable; The reference group= [¥]Female, [€]unmarried status, [$]assistant pharmacist, [¶]Singlepharmacy, [#]No drug consultation service, [£]one practice location, [‡]City of Bandung location; red colour: p-value < 0.05

Supplementary File 5. The multivariable logistic regression for sub-group analysis of the characteristics male gender among the participants (n= 1,125)

Variables	p-value	Odds ratio	95% CI	
			Min.	Max.
Participant characteristics				
Married status€	0.13	0.75	0.51	1.09
Age*	0.00	1.05	1.02	1.08
Professional characteristics				
Pharmacist$	0.34	1.21	0.82	1.79
Chain Pharmacist¶	0.11	1.39	0.93	2.08
Working experience	0.91	1.00	0.97	1.03
Providing drug information service#*	0.02	1.68	1.10	2.56
Availability of medical doctor practice	0.51	1.12	0.80	1.55
Experience in TB training	0.71	0.94	0.69	1.29
Working hours per week	0.34	1.00	0.99	1.02
Two practice locations£	0.21	1.40	0.83	2.37
Three practice locations£	0.76	0.89	0.42	1.88
Study Sites				
County of Bandung‡	0.10	1.47	0.93	2.33
Makassar‡	0.53	0.86	0.54	1.37
Medan‡	0.61	0.88	0.54	1.43
Knowledge and Attitude on TBPD				
Knowledge	0.24	0.97	0.93	1.02
Attitude*	0.00	1.10	1.04	1.16

Information: * The significant variable (p<0.05); Reference group= = €unmarried status, $pharmacy technician, ¶Single pharmacy, #No drug consultation service, £one practice location, ‡City of Bandung location; CI: Confidence Interval; red colour: p-value < 0.05

STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Recommendation	Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4
Objectives	3	State specific objectives, including any prespecified hypotheses	4
Methods			
Study design	4	Present key elements of study design early in the paper	5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	5
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6-7
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	6-7
Bias	9	Describe any efforts to address potential sources of bias	15
Study size	10	Explain how the study size was arrived at	6
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	6-7
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	7
		(*b*) Describe any methods used to examine subgroups and interactions	7
		(*c*) Explain how missing data were addressed	7
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	n.a
		(*e*) Describe any sensitivity analyses	n.a
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	8
		(b) Give reasons for non-participation at each stage	8
		(c) Consider use of a flow diagram	Fig.1
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	8 & table. 1
		(b) Indicate number of participants with missing data for each variable of interest	n.a
Outcome data	15*	Report numbers of outcome events or summary measures	Table 2-4

Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	9 & Supl.4 & 5
		(*b*) Report category boundaries when continuous variables were categorized	n.a
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	n.a
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	n.a
Discussion			
Key results	18	Summarise key results with reference to study objectives	13
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	15
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	13-14
Generalisability	21	Discuss the generalisability (external validity) of the study results	15
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	19

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.