Original Article

Evaluating the Impact of a Pharmacist-Led Educational Intervention in Enhancing Pulmonary Tuberculosis Awareness in Malaysia

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ABSTRACT

OBJECTIVE: To evaluate how a pharmacist's counselling can raise awareness regarding the disease.
METHODOLOGY: A single-blinded randomized controlled trial was conducted at Hospital Pulau Pinang from December 2023 to December 2024. A total of 206 participants with confirmed PTB were randomly selected and included in the study. Participants included in the intervention arm received structured Pharmacist counselling in addition to directly observed therapy (DOT). The control arm received DOT from the nurses. The data were collected at baseline, 2 months, 4 months, and 6 months after treatment completion. Data were analyzed at baseline and at 6 months. Between-group differences at follow-up were analyzed using baseline-adjusted comparisons. Data were analyzed using SPSS version 28. This trial was registered at ClinicalTrials.gov (Identifier: NCT06608069).
RESULTS: The intervention group showed significantly improved knowledge of treatment (p = 0.01), preventive measures (p = 0.01), and PTB symptoms (p = 0.01) compared with the control group. This result was sustained after the completion of the treatment as well. At 6 months, the intervention group demonstrated significantly higher knowledge across multiple domains compared with the control group (p < 0.05), with a medium effect size (Cramer's V = 0.30). The regression analysis showed that males and smoking status were associated with disease knowledge.
CONCLUSION: The educational counselling provided by the Pharmacist had a significant impact on participants' awareness of disease knowledge. This study emphasizes the participation of pharmacists as educators and health counsellors for better disease management.

KEYWORDS: Pharmacist-led intervention, tuberculosis, disease knowledge, pulmonary tuberculosis, patient education

INTRODUCTION

Tuberculosis is the leading infectious disease causing mortality globally, specifically targeting vulnerable populations like people living with HIV[1]. According to the latest estimates provided by the WHO, 10 million new TB cases are recorded annually, and Southeast Asian countries bear the major burden of PTB. Malaysia, as a country, faces persistent challenges regarding the management of PTB due to poor awareness regarding the disease, delayed diagnosis, non-adherence to treatment, and drug resistance[2]. These are a few major reasons why educational counselling is needed for patients living with PTB.

To improve PTB management of PTB, the involvement of pharmacists should be encouraged to enhance disease knowledge, as they play an important role in patient education and counselling[3]. Pharmacists can improve treatment outcomes by counselling patients on disease awareness, the benefits of adherence, and better management of adverse drug reactions (ADRs)[4]. Clinical pharmacists are uniquely positioned to provide valuable educational interventions that can directly influence patients' understanding of their disease, treatment plan, and the importance of adherence[5].

Disease knowledge is a critical determinant of patient behavior in TB management. Adequate understanding of disease transmission, symptoms, treatment duration, and preventive measures has been shown to influence treatment adherence, reduce misconceptions, and promote early health-seeking behavior. Improved patient knowledge is therefore considered an important intermediate outcome that can lead to better clinical outcomes, including reduced treatment interruptions, improved adherence, and a lower risk of disease transmission and drug resistance. Given that behavioral change is a key component of successful TB control, evaluating knowledge provides an important measure of the effectiveness of educational interventions.

However, most existing studies have focused primarily on adherence and treatment outcomes, with limited

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doi: 10.22442/jlumhs.2026.01403
Received: 14-10-2025 Revised: 15-12-2025
Accepted: 18-12-2025 Published Online: 20-12-2025

evidence on the direct impact of pharmacist-led interventions on patients' disease knowledge. Furthermore, evidence from randomized controlled trials evaluating structured pharmacist-led educational programs in TB care remains scarce, particularly in the Malaysian context.

METHODOLOGY

Study Design

A prospective randomized controlled trial was conducted from December 2023 to December 2024 at Hospital Pulau Pinang. A total of 206 participants were included in the study, 103 in the control arm and 103 in the intervention arm. A simple parallel-group design was employed, consisting of one intervention group and one control group. In the intervention group, after baseline data collection, the Pharmacist conducted a structured educational counselling session. The control group received standard care, which was DOT provided by nurses. Data were collected at baseline, 2 months, 4 months, and completion of treatment (i.e., 6 months).

Trial Registration

The protocol for this study has already been published in the Monaldi Archives for Chest Disease, 2025; under doi: 10.4081/monaldi.2025.3474[6]. This trial is registered at ClinicalTrials.gov: NCT06608069.

Ethical Approval

Ethical approval for this study was obtained from the Medical Research and Ethics Committee (MREC), Ministry of Health Malaysia (Approval No.: NMRR ID-22-01964-WWH). Written informed consent was obtained from all participants before enrollment. The study was conducted in accordance with the principles of the Declaration of Helsinki.

Inclusion and Exclusion criteria

This study included participants whose diagnosis was confirmed by sputum smear test and chest X-ray. Those participants were following the first-line anti-TB regimen. Participants were at least 18 years of age. Participants who had a basic understanding of and speaking skills in English and Malay were included in this study.

Participants who were pregnant were excluded from the study because TB management during pregnancy requires specialized clinical monitoring and counselling considerations, which may differ from standard care and could introduce clinical and educational heterogeneity affecting study outcomes. Additionally, participants enrolled in other studies were not included. Patients who wanted to transfer out, were lost to follow-up, and had treatment failure were not part of the study.

Sample Size

The sample size for this randomized controlled trial was calculated based on the primary outcome of the parent study, treatment adherence, as described in the published study protocol (6). The calculation was performed using the two-population means formula. A two-sided significance level of 0.05 ($Z\alpha/2 = 1.96$) and a statistical power of 80% ($Z_\beta = 0.84$) were assumed. Based on previous literature, a standard deviation (σ) of 0.25 and an expected difference (d) of 0.10 (10% improvement between groups) were used.

Using the formula: $n = (Z\alpha/2 + Z_\beta)^2 \times 2\sigma^2 / d^2$

The required sample size was calculated to be 98 participants per group. To account for an anticipated 5% loss to follow-up, the sample size was increased to 103 participants per group, for a total of 206 patients.

Randomization, blinding, and allocation of the Participants

Participants who provided written informed consent were enrolled consecutively by the study investigator. An independent researcher, who was not involved in participant recruitment, intervention delivery, or outcome assessment, generated the random allocation sequence in advance using computer-generated random numbers in Microsoft Excel (simple randomization) for a 1:1 allocation ratio. Allocation concealment was ensured using sequentially numbered, sealed, opaque envelopes prepared by the independent researcher. Each envelope contained the group assignment (intervention or control). Baseline data were collected for all participants before group assignment. After completion of the baseline assessment, the independent researcher opened the next envelope in sequence and assigned the participant accordingly. This procedure ensured allocation concealment until after baseline measurements and minimized the risk of selection bias. For data analysis, group identifiers were masked and replaced with neutral codes (Group A and Group B) to reduce analytical bias.

Due to the nature of the pharmacist-led educational intervention, blinding of participants and the intervention provider was not feasible. Participants were aware of whether they received additional counselling, and the Pharmacist delivering the intervention was also aware of group allocation. However, to minimize bias, outcome assessment was conducted using standardized questionnaires administered uniformly to both groups. During data analysis, group allocation was masked by replacing group identifiers with neutral codes. The data analyst was not aware of the actual group assignments until completion of the analysis was complete.

Pharmacist Educational Intervention

The intervention consisted of a structured, pharmacist-led educational counselling session delivered one-to-one at baseline after randomization. Each session lasted approximately 20 minutes and was conducted individually to allow personalized interaction and clarification of patient concerns. The structured counselling content was adapted from authentic references and guidelines on TB management provided by the WHO, the Ministry of Health, Malaysia, and the Centres for Disease Control and Prevention (CDC). The content and face validation were done before administering the educational

intervention. The Pharmacist underwent rigorous training before administering the educational intervention. The purpose of the training was to develop the skills and competency in PTB education and counselling. The Pharmacist followed the CDC's Self-Study Modules and the WHO consolidated guidelines on TB for the training.

Study tool

A pre-validated questionnaire was used to collect data from participants after obtaining permission to administer it [7]. The maximum score was 25. TB knowledge was assessed using a validated questionnaire consisting of 25 binary items (correct = 1, incorrect = 0). Although a total score (range 0–25) can be derived, the present analysis focused on item- and domain-level comparisons to provide a detailed assessment of knowledge changes across specific content areas.

Statistical Analysis

The data were analyzed using version 28 of SPSS. For categorical variables, percentages were calculated; for continuous variables, mean and standard deviation were calculated. Chi-square was used to compare two categorical variables, while the association between sociodemographic factors and disease knowledge was assessed using regression analysis. Effect size was interpreted using standard criteria for Cramer's V, where values of approximately 0.10 indicate a small effect, 0.30 a medium effect, and 0.50 or above a large effect.

RESULTS

Sociodemographic and Clinical characteristics of the participants

The baseline sociodemographic and clinical characteristics were generally comparable between the groups. Most participants were male and aged 45 –64 years, and smear-positive pulmonary tuberculosis was the predominant disease type in both groups. The distribution of nationality, smoking status, HIV status, and comorbidities was similar across groups, although differences were observed in marital status, BMI, and baseline lung cavitation (**Table I**).

Table I: Sociodemographic characteristics of patients (n = 206)

Variables	Control Group n (%)	Intervention group n (%)
Gender		
Male	68 (66.0)	73 (70.9)
Female	35 (34.0)	30 (29.1)
Age (years)		
18-44	33 (32.0)	28(27.2)
45-64	42 (40.8)	38(36.9)
≥65	28 (27.2)	37(35.9)
Nationality		
Malay	40 (38.8)	40(38.8)
Chinese	45 (43.7)	47(45.6)
Indian	18 (17.5)	16(15.5)
Marital Status		
Married	80 (77.7)	94 (91.3)
Unmarried	23 (22.3)	9 (8.7)
Types of PTB		
Smear positive	71 (68.9)	65 (63.1)
Smear negative	32 (31.1)	38 (36.9)
BMI		
Underweight	39 (37.9)	15 (14.6)
Normal weight	51 (49.5)	82 (79.6)
Overweight	13 (12.6)	6 (5.8)
HIV		
Negative	102 (99.1)	102 (99.1)
Positive	1(0.9)	1(0.9)
Drug Use		
Yes	8(7.8)	5 (4.9)
No	95(92.2)	98 (95.1)
Smoking		
Yes	37 (35.9)	27 (26.2)
No	66 (64.1)	76 (73.8)
Comorbidities		
Pneumonia	19 (18.4)	14 (13.6)
Liver disorder	17 (16.5)	19 (18.4)
Diabetes mellitus	8 (7.8)	14 (13.6)
Hematological disorder	15 (14.6)	3 (2.9)
Malnutrition	6 (5.8)	1 (1)
Electrolyte distribution	5 (4.9)	0 (0)
Gastric disorder	9 (8.7)	0 (0)
Empyema	6 (5.8)	0 (0)
Kidney disorder	1 (1.0)	16 (15.5)
Chronic Obstructive Pulmonary	2 (1.9)	0 (0)
Disease	15 (14.6)	36 (35.0)
Baseline Lung Cavitation		
No cavitation	18 (17.5)	67 (65.0)
Unilateral cavitation	56 (54.4)	25 (24.3)
Bilateral cavitation	29 (28.2)	11 (10.7)

Effect of Pharmacist intervention on Disease knowledge at baseline

Although participants were randomized, baseline differences in knowledge between groups were observed, likely due to chance. For instance, 94.2% of the intervention group correctly identified that TB treatment is free, compared to 82.5% in the control group (p=0.01). Similarly, the intervention group demonstrated higher awareness of TB prevention measures, with 100% understanding that not spitting everywhere is crucial, compared to 97.2% in the control group (p=0.01). **Table II**

Effect of Pharmacist intervention on Disease knowledge at treatment completion

At the 6-month follow-up, the intervention group demonstrated significant improvements in TB disease knowledge compared to the control group. Key gains included 100% awareness of TB treatment being free (vs 88.3%, p=0.01, effect size=0.3), and better understanding of TB transmission through sharing food containers (93.3% vs 11.7%, p=0.01, effect size=0.3). The intervention group also showed

Table II: Measure of PTB disease knowledge at baseline

Outcome measures	Control group		Intervention group		*p-value**
	Yes (%)	No (%)	Yes (%)	No (%)	
Knowledge of TB disease					
TB is an infectious disease.	67 (65)	36 (35)	77 (74.8)	26 (25.2)	0.1
TB is caused by germs.	80 (77.7)	23 (22.3)	86 (83.5)	17 (16.5)	**0.03**
TB can be spread through sharing food containers.	84 (81.6)	19 (18.4)	76 (73.8)	27 (26.2)	1
The lungs are the part of the body most often attacked by TB.	62 (60.2)	41 (39.8)	60 (58.3)	43 (41.7)	0.5
TB disease can be treated.	89 (86.4)	14 (13.6)	97 (94.2)	6 (5.8)	0.4
TB can be fatal if not treated properly.	85 (82.5)	18 (17.5)	84 (81.6)	19 (18.4)	0.7
TB treatment in this country is free.	85 (82.5)	18 (17.5)	103 (100)	0 (0)	**0.01**
Smoking has a relation with having TB.	93 (90.3)	10 (9.7)	103 (100)	0 (0)	0.1
The number of TB cases in this country is still high.	90 (87.4)	13 (12.6)	96 (92.3)	7 (6.8)	0.1
People infected with HIV easily get TB disease.	59 (57.3)	44 (42.7)	89 (86.4)	14 (13.6)	0.2
A balanced diet can reduce TB infection.	89 (86.4)	14 (13.6)	88 (85.4)	15 (14.6)	**0.01**
Symptoms of TB					
Sputum production	84 (81.6)	19 (18.4)	82 (79.6)	21 (20.4)	0.7
Cough for more than 2 weeks	88 (85.4)	15 (14.6)	62 (60.2)	41 (39.8)	**0.01**
Prolonged fever	83 (80.6)	20 (19.4)	101 (98.1)	2 (1.9)	**0.01**
Loss of appetite	86 (85.9)	17 (14.1)	76 (80.9)	27 (19.1)	0.2
Chest pain	94 (91.3)	9 (8.7)	94 (91.3)	9 (8.7)	**0.01**
Fatigue	103 (100)	0 (0)	92 (89.3)	11 (10.7)	**0.01**
Lose weight	47 (45.6)	56 (54.4)	99 (96.1)	4 (3.9)	**0.01**
Blood in sputum	59 (57.3)	44 (42.7)	98 (95.1)	5 (4.9)	**0.01**
Sweating in the evening/night	102 (99.0)	1 (1.0)	83 (85.8)	20 (14.2)	**0.0.1**
Prevention of TB					
Cover your mouth or nose if you cough or sneeze	89 (86.4)	14 (13.6)	97 (94.2)	6 (5.8)	**0.04**
Opening the windows of the house allows light and air to enter	95 (92.2)	8 (7.8)	94 (91.3)	9 (8.7)	0.1
Undergo immediate examination if there are signs and symptoms of TB	94 (91.3)	9 (8.7)	97 (94.2)	6 (5.8)	0.8
Not spitting all over the place	94 (97.2)	9 (2.8)	103 (100)	0 (0.0)	**0.01**
Stay in a crowded room	93 (90.3)	10 (9.7)	88 (85.4)	15 (14.6)	0.1

**Chi-square*

improved recognition of TB symptoms, such as prolonged fever (98.1% vs 91.3%, p=0.01, effect size=0.3) and loss of appetite (91.3% vs 87.4%, p=0.2, effect size=0.3). Knowledge of prevention measures, including not spitting in public, remained high in the intervention group (100% vs 92.2%, p=0.01, effect size=0.3). **Table III**.

Multivariate Regression Analysis by Patients' Characteristics

The multivariate linear regression analysis in **Table IV** revealed significant associations between disease knowledge and patient characteristics in both the control and intervention groups. In the control group, smoking status was a significant predictor of disease knowledge, with smokers showing better knowledge compared to non-smokers (β = 0.9, p = 0.01). Additionally, gender was significantly associated with disease knowledge in both groups; males had higher knowledge scores than females in both the control (β = 1.3, p = 0.05) and intervention groups (β = 1.5, p = 0.05).

DISCUSSION

This study discussed the effect of pharmacist educational interventions in improving disease knowledge among PTB patients. Pharmacists play an important role in optimizing patient care, yet their role remains underutilized. This study focused on the role of the Pharmacist as a patient educator and counsellor. The results clearly demonstrate that the intervention significantly enhanced patients' awareness across a broad spectrum of TB-related topics, including transmission, treatment, symptoms, and prevention. Both baseline and six-month follow-up assessments confirmed that the pharmacist-led educational intervention effectively improved and sustained TB knowledge among participants.

This result aligns with previous studies conducted in Indonesia, South Africa, and India. The studies concluded that after the counselling provided by the

Table III: Measure of PTB disease knowledge on 6th month

Outcome measures	Control group Mean± SD		Intervention group Mean± SD		*p-value**	Effect size
	Yes (%)	No (%)	Yes (%)	No (%)		
Knowledge of TB disease						
TB is an infectious disease.	91 (88.3)	12 (11.7)	92 (89.3)	11 (10.7)	0.01	0.1
TB is caused by germs.	93 (93.3)	10 (9.7)	92 (89.3)	11 (10.7)	**0.03**	0.3
TB can be spread through sharing food containers.	12 (11.7	91 (88.3)	10 (9.7)	93 (93.3)	**0.01**	0.3
The lungs are the part of the body most often attacked by TB.	68 (66.0)	35 (34.0)	93 (93.3)	10 (9.7)	0.05	0.3
TB disease can be treated.	93 (93.3)	10 (9.7)	103 (100)	0 (0)	0.01	0.1
TB can be fatal if not treated properly.	90 (87.4)	13 (87.4)	93 (93.3)	10 (9.7)	0.01	0.3
TB treatment in this country is free.	103 (100)	0 (0)	103 (100)	0 (0)	**0.01**	0.3
Smoking has no relation with having TB.	103 (100)	0 (0)	103 (100)	0 (0)	0.01	0.3
The number of TB cases in this country is still high.	103 (100)	0 (0)	3 (2.9)	100 (97.1)		0.1
People infected with HIV easily get TB disease.	93 (93.3)	10 (9.7)	103 (100)	0 (0)	0.01	0.3
A balanced diet can reduce TB infection.	93 (93.3)	7 (9.7)	103 (100)	0 (0)	**0.01**	0.3
Symptoms of TB						0.3
Sputum production	90 (87.4)	13 (87.4)	96 (91.3)	7 (8.7)	0.01	0.1
Cough for more than 2 weeks	90 (87.4)	13 (87.4)	93 (93.3)	10 (9.7)	**0.01**	0.3
Prolonged fever	96 (91.3)	7 (8.7)	101 (98.1)	2 (1.9)	**0.01**	0.3
Loss of appetite	90 (87.4)	13 (87.4)	96 (91.3)	7 (8.7)	0.2	0.3
Chest pain	94 (91.3)	9 (8.7)	96 (91.3)	7 (8.7)	**0.01**	0.1
Fatigue	90 (87.4)	13 (87.4)	93 (93.3)	10 (9.7)	**0.01**	0.3
Lose weight	103 (100)	0 (0)	103 (100)	0 (0)	**0.01**	0.3
Blood in sputum	68 (66.0)	35 (34.0)	99 (96.1)	4 (3.9)	**0.01**	0.3
Sweating in the evening/night	59 (57.3)	44 (42.7)	99 (96.1)	4 (3.9)	**0.0.1**	0.1
Prevention from TB						0.3
Cover your mouth or nose if you cough or sneeze	103 (100)	0 (0)	103 (100)	0 (0)	**0.01**	0.3
Opening the windows of the house allows light and air to enter	90 (86.4)	13 (13.6)	99 (94.2)	4 (5.8)	**0.01**	0.3
Undergo immediate examination if there are signs and symptoms of TB	95 (92.2)	8 (7.8)	99 (94.2)	4 (5.8)	**0.01**	0.2
Not spitting all over the place	95 (92.2)	8 (7.8)	103 (100)	0 (0.0)	**0.01**	0.2
Stay in a crowded room	95 (92.2)	8 (7.8)	103 (100)	0 (0.0)	**0.01**	0.3

**Chi-square test. Cramer's v test measures effect size. Effect size criteria are small (around 0.10), medium (0.30), and large (0.50)*

Table IV: Association between Disease knowledge and patients' characteristics using multivariate linear regression

Variables	Control Group Multivariate Linear Regression		Intervention Group Multivariate Linear Regression	
	Unstandardized β [95%CI)	*p*-value	Unstandardized β [95%CI)	*p*-value
Gender				
Male vs Female	1.3 (1.2-1.6)	**0.05**	1.5 (0.8-1.8)	**0.05**
Age				
18-44 vs 45-64	Not applied	-	0.03 (-0.1-2.2)	0.6
18-44 vs ≥65	Not applied	-	0.04 (-0.6-2.9)	0.5
Marital Status				
Married vs Unmarried	Not applied	-	0.2 (-0.3-0.5)	0.2
HIV				
Non-reactive vs Negative	0.6 (-0.1-0.8)	0.2	0.5 (-0.6-0.8)	0.1
Smoking				
Yes vs No	0.9 (0.4-2.1)	**0.01**	0.4 (0.4-1.2)	**0.01**

BMI: Body Mass Index, CI: Confidence Interval, Univariate analysis for significant variations with p < 0.2 was included in multivariate linear regression

Pharmacist, disease awareness increased, and patients were motivated to continue and seek better health care [8-10]. Another study by Leech LVJ 2022 [11] provided evidence of the Pharmacist's role in helping patients understand medication therapy for cardiac-related disorders.

To support evidence on the role of Pharmacist counselling in raising awareness of TB and sustaining knowledge, a study showed that patients in the intervention group had better identification of TB due to persistent cough and hemoptysis [12]. Early identification of symptoms leads to early diagnosis and supports successful treatment outcomes.

A similar pattern was observed in a study by Mutalikdesai N et al. [13] who proved that by providing a tailored education, patients developed a better understanding of the disease, which led to early diagnosis and treatment. Additionally, the American Journal of Health-System Pharmacy reported that the intervention group showed better adherence than the control group [14]. These steps by pharmacists help improve understanding of the disease, which can lead to earlier diagnosis and better treatment management.

Regression analysis showed that males had better knowledge than females in both groups. This indicated gender bias and disparities in healthcare settings. The studies in Vietnam and Bangladesh established that men have better knowledge regarding the disease than women due to access to better healthcare, as well as knowledge [15,16]. These findings align with a study conducted in China, which found that men were well informed about diagnostic procedures, treatment, and TB precautions [17]. These disparities may reflect differences in literacy rates and access of information between genders. A systematic review opposed these findings, suggesting no significant difference in awareness levels between genders. It focuses on and emphasizes the variability among different populations and cultures [18]. Current smokers had a significant association with disease knowledge. Although smoking is associated with adverse health outcomes in TB, smokers have more exposure to smoking cessation clinics and have better awareness regarding the disease [19,20].

This study provides a detailed and comprehensive evaluation of TB awareness, including knowledge of signs and symptoms, diagnosis, and prevention. We incorporated effect size to evaluate the practical implications of the intervention.

The principal strengths of this study include its comprehensive measurement of TB knowledge across multiple domains and the incorporation of effect size analyses to assess the intervention's practical impact. This study has several limitations to consider when interpreting the findings. First, the study was conducted at a single tertiary care center, which may limit the generalizability of the results to other healthcare settings or populations with different sociodemographic characteristics. Second, TB knowledge was assessed using a self-reported questionnaire, which may be subject to social-desirability bias or recall bias, potentially leading to overestimation of knowledge levels. Third, the present analysis focused on knowledge outcomes and did not evaluate behavioral or clinical endpoints such as medication adherence, treatment completion, or clinical recovery; therefore, the direct impact of improved knowledge on clinical outcomes cannot be confirmed. Finally, because participants were recruited from the same clinical setting, there was a possibility of information contamination between groups, whereby patients in the control arm may have obtained information from participants who received the intervention. These factors should be considered when interpreting the magnitude and applicability of the observed effects.

CONCLUSION

This study demonstrated that pharmacist-led educational counselling significantly improved tuberculosis-related knowledge among patients with pulmonary tuberculosis and that these improvements were sustained at follow-up. The findings support the potential role of pharmacists as patient educators to enhance disease awareness within tuberculosis care programs. However, as this study evaluated knowledge outcomes only, the impact of improved knowledge on clinical outcomes cannot be assumed. Future research should examine whether pharmacist-led educational interventions improve medication adherence, treatment success, and health-related quality of life. In addition, studies assessing the cost-effectiveness and feasibility of integrating pharmacists as educators within routine tuberculosis control programs are warranted.

Acknowledgements: We thank the Director General of Health Malaysia for permission to publish this article.

Ethical Permission: Ministry of Health, Malaysia, ERC approval letter No. NMRR ID-22-01964-WWH.

Statement of Informed Consent: - Informed consent was obtained for this study.

Conflict of interest: There is no conflict of interest between the authors.

Financial Disclosure / Grant Approval: No funding agency was involved in this research.

Data Sharing Statement: The corresponding author can provide the data supporting the findings of this study on request. Privacy or ethical restrictions bound us from sharing the data publicly.

AUTHOR CONTRIBUTION

Ahmad R: Study concept, and drafting and revising the work for important intellectual content, Statistical analysis and interpretation of data for the work Sheikh Ghadzi SM: Conception and design of the work or the acquisition, Final approval of the version to be published

Hussain A: Data collection, revisions of the initial idea Syed Sulaiman SA: Conception and design of the work or the acquisition, Final approval of the version to be published

Hyder Ali IAB: Conception and design of the work or the acquisition, Final approval of the version to be published

Khan AH: Conception and design of the work or the acquisition, Final approval of the version to be published.

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