



UNIVERSITI PUTRA MALAYSIA

**KNOWLEDGE, ATTITUDE AND PRACTICE AMONG DAIRY CATTLE
FARMERS AND WORKERS AT DAIRY CATTLE FARM ON BOVINE
TUBERCULOSIS**

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**KNOWLEDGE, ATTITUDE AND PRACTICE AMONG DAIRY CATTLE FARMERS
AND WORKERS AT DAIRY CATTLE FARM ON BOVINE TUBERCULOSIS**



STANLEY LIM

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CERTIFICATION

It is hereby certified that we have read this project paper entitled “Knowledge, Attitude and Practice among Dairy Cattle Farmers and Workers at Dairy Cattle Farm on Bovine Tuberculosis”, by Stanley Lim and in our opinion it is satisfactory in terms of scope, quality and presentation as partial fulfillment of the requirements for the course VPD 4999- Final Year Project.

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DEDICATION

This thesis is dedicated to:

My God, thank you for giving me the strength to survive.

My patient supervisor, Dr. Sharina Omar

My parents, thank you for the motivations and support throughout my entire life.

My "Imam" friend "Ahmad Syahmi", thank you for the motivations and sharing of religious knowledge whenever I need.

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Dr. Sharina Omar

Dr. Siti Zubaidah Ramanoon

Encik Jeffri LAW & all dairy cattle farmers

My family

Friends & DVM 2024

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LIST OF ABBREVIATIONS



<i>M. bovis</i>	<i>Mycobacterium bovis</i>
KAP	Knowledge, Attitude, Practice
bTB	Bovine tuberculosis
WOAH	World Organisation for Animal Health
WHO	World Health Organization
WAHIS	World Animal Health Information System
FAO	Food and Agriculture Organization

Abstrak

Abstrak daripada kertas projek yang dikemukakan kepada Fakulti Perubatan Veterinar untuk memenuhi memenuhi sebahagian daripada keperluan kursus VPD 4999- Projek Tahun Akhir

Pengetahuan, Sikap dan Amalan Penternak dan Pekerja Ladang Lembu Tenusu Terhadap

Tuberculosis Bovin

Oleh

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2023

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Tuberkulosis bovin (bTB) adalah penyakit zoonotik kronik berjangkit yang disebabkan oleh *Mycobacterium tuberculosis*, terutamanya *M. bovis*, yang menjejaskan pelbagai spesies haiwan, termasuk lembu, rusa, kambing dan manusia. bTB ditemui di kebanyakan kawasan di Asia dan lembu merupakan sumber jangkitan utama kepada manusia. Tuberkulosis bovin adalah penyakit serius yang boleh menyebabkan kerugian ekonomi yang besar pada industri tenusu. Kajian ini bertujuan untuk menyiasat pengetahuan, sikap dan amalan penternak dan pekerja ladang lembu tenusu terhadap tuberkulosis bovin. Oleh itu, satu tinjauan sukarela telah direkabentuk yang

menyasarkan penternak lembu tenusu dan pekerja warganegara Malaysia berusia 18 tahun ke atas. Senarai hubungan penternak lembu tenusu diperolehi daripada DVS Selangor. Penternak lembu tenusu di Selangor telah dihubungi dan ditanya sekiranya mereka dengan sukarela ingin menyertai kajian ini. Sejumlah 21 responden telah menyertai kajian ini sepanjang tempoh tinjauan selama 5 minggu. Tinjauan dijalankan melalui temubual telefon (n=1), *Google Form* (n=8) dan lawatan ladang (n=12). Data yang diperolehi dianalisis menggunakan IBM SPSS versi 27.0 dan diringkaskan menggunakan statistik deskriptif. *Modified Bloom Cut Off Point* telah dijadikan rujukan bagi penskoran untuk menilai tahap pengetahuan, sikap dan amalan (KAP) responden. Ujian tepat *Fischer* digunakan untuk menentukan faktor terkait dengan tahap KAP dikalangan penternak ladang lembu tenusu terhadap tuberkulosis bovin. Keputusan menunjukkan bahawa 14.29% penternak (n=3) mempunyai KAP yang baik, 47.62% (n=10) sederhana dan 38.1% (n=8) mempunyai KAP lemah terhadap tuberkulosis bovin. Faktor terkait yang signifikan dengan KAP terhadap tuberkulosis bovin ialah kewujudan haiwan import di ladang ($p=0.044$). Juga, tahap KAP terhadap tuberkulosis bovin adalah sederhana dikalangan penternak lembu tenusu di Selangor. Ini menunjukkan veterinar perlu memperbaiki program kesedaran bagi meningkatkan tahap KAP terhadap bTB dalam komuniti penternak tenusu dalam negara.

Abstract

An abstract of the project paper presented to the Faculty of Veterinary Medicine in partial fulfillment of the course VPD 4999-Final Year Project.

KNOWLEDGE, ATTITUDE AND PRACTICE AMONG DAIRY CATTLE FARMERS AND WORKERS AT DAIRY CATTLE FARM ON BOVINE TUBERCULOSIS

By

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2023

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Bovine tuberculosis (bTB) is a chronic infectious zoonotic disease caused by the *Mycobacterium tuberculosis*, primarily by *M. bovis*, which affects various animal species, including cattle, deer, goats and humans. bTB is found in most parts of Asia and cattle are the main source of infection for humans. Bovine tuberculosis is a serious disease that can cause big economic loss to the dairy industry. This study aims to investigate the knowledge, attitude and practice of dairy cattle farmers and workers towards bovine tuberculosis. Hence, a voluntary survey targeting Malaysian dairy cattle farmers and workers aged 18 years old and above was designed. Contact list of dairy cattle farmers was retrieved from the Department of Veterinary Services of Selangor. Dairy cattle farmers in Selangor were contacted and asked if they would like to volunteer in this study. A total of 21 respondents participated in the study during the 5-weeks survey period. Surveys were

done through phone call interviews (n=1), Google Form (n=8) and farm visits (n=12). The data obtained was analyzed using IBM SPSS version 27.0 and summarized by descriptive statistics. Modified Bloom's cut-off point was used as a reference for scoring to assess the overall knowledge, attitude and practice (KAP) of the respondents. Fischer's exact test was used to determine the factors associated with the level of KAP among dairy farmers towards bovine tuberculosis. The results showed that 14.29% of farmers (n=3) had good knowledge, attitude and practice (KAP), 47.62% (n=10) moderate and 38.1% of farmers (n=8) had poor KAP towards bovine tuberculosis. The significantly associated factor with KAP towards bovine tuberculosis was the presence of imported animals (p=0.044). Also, the level of KAP among dairy farmers in Selangor towards bovine tuberculosis was moderate. This indicates veterinarians should improve the awareness programs to raise KAP level on bTB in dairy farmers community in the country.

1.0 Introduction

1.1 Background

Bovine tuberculosis (bTB) is a chronic bacterial disease primarily caused by *Mycobacterium bovis* (*M. bovis*) and *Mycobacterium caprae* in addition to a lesser extent, *Mycobacterium tuberculosis*. According to the reports submitted to World Animal Health Information System (WAHIS), bTB is found in most parts of Asia (OIE, 2022). It is a serious infectious disease that affects cattle, as well as other farmed animals and certain wildlife. Cattle are the primary reservoir for *M. bovis* and the primary source of infection in humans related to *M. bovis*. The bacteria can be transmitted to humans via the consumption of unpasteurised raw milk, thus representing an important public health risk (Collins et al., 2022). The disease is contagious and can be transmitted by direct contact with infected domestic and wild animals or indirectly by ingestion of contaminated material. Inhalation of infected aerosol droplets is considered as the most common route of the infection (Xu et al., 2021). Calves can be infected by ingesting colostrum or milk from infected cows. The sharing of grazing and drinking points amongst the herds and with wildlife were identified as risky practices for *M. bovis* infection transmission to cattle (Sichewo et al., 2020). The disease causes increased mortality, reduced milk and meat productivity, reduced fertility, and organ or carcass condemnations at abattoirs due to visible TB-like lesions, and eventually impacting the economy (Tschopp et al., 2021).

Sadiq et al. (2021) showed that Malaysian ruminant farmers in the Selangor had low awareness of zoonotic diseases in which only 17.8% of the respondents were aware of tuberculosis. Since 2017, the Ministry of Health (MOH) and Department of Veterinary Services (DVS) of Malaysia

has been organizing surveillance activities and information sharing with aims to eradicate this zoonotic disease by 2020. However, the disease is still present to date (WHO, 2020).

Hence, this survey was carried out with two objectives to undermine the reason for the unsuccessful campaign:

1. To evaluate the KAP levels on bovine tuberculosis among dairy cattle farmers in Selangor.
2. To determine the association between demographic factors and KAP scores of dairy cattle farmers in Selangor towards bovine tuberculosis.

1.2 Justification

The knowledge on bovine tuberculosis is widely known, however, cases of bovine tuberculosis are still being reported. Similar studies had been done in the past to investigate the knowledge, attitude and practice of dairy farmers regarding zoonotic diseases. However, no study has been done specifically for bovine tuberculosis. Therefore, this study aims to investigate the knowledge, attitude and practice of dairy farmers in handling bovine tuberculosis cases in herds, along with the preventive measures taken. From this investigation, a better education and awareness regarding bovine tuberculosis can then be channeled to local dairy farmers.

2.0 Literature Review

2.1 Bovine tuberculosis as zoonoses in dairy cattle

Bovine tuberculosis (bTB) is a chronic bacterial disease of animals caused by members of the *Mycobacterium tuberculosis* complex, mainly by *Mycobacterium bovis*. It is a major zoonotic disease, and cattle are the main source of infection for humans, especially through the consumption of unpasteurized dairy products or contaminated meat from infected animals. It also affects other animals such as goats, sheep, pigs, dogs, cats, and wildlife species such as wild boars, deer, and antelopes.

The transmission of bTB occurs mainly through inhalation of aerosols containing the bacteria, but also through ingestion of contaminated food or water, or direct contact with infected animals or carcasses. The clinical signs of bTB vary depending on the host species, the stage of infection, and the organ system involved. They may include weight loss, coughing, dyspnea, enlargement of lymph nodes, mastitis, lameness, and paralysis.

In general, the diagnosis of bTB is based on the identification of the immune response, the demonstration of lesions compatible with the disease and the detection of the bacteria. The most widely used diagnostic methods are the tuberculin skin test, the interferon-gamma assay, and the culture or molecular identification of the bacteria from samples (WOAH, 2023). However, these methods have limitations in terms of sensitivity, specificity, cost, and availability. Therefore,

there is a need for new diagnostic tools and biomarkers that can improve the detection and control of bTB (Blanco et al., 2022).

The prevention of bTB relies on the implementation of surveillance and control programs that include testing, culling, and restrictions of movement of the infected animals, as well as biosecurity measures to prevent the contact between domestic and wild animals. Another possible method of preventing bTB is through vaccination, however, this approach has drawbacks such as the interference with the tuberculin skin test, the lack of effective vaccines for all host species, and the regulatory and ethical issues involved (Chandran et al., 2019). A number of potential vaccines have been tested in animal models or field trials, none of them has been licensed for use in cattle or wildlife (Chandran et al., 2019). Among these was a novel BCG vaccine for cattle which are currently undergoing field testing and is supposed to shield the herd against bTB without interfering with the present diagnostic procedures (McFadden et al., 2019).

Bovine tuberculosis is a serious problem for animal and human health in many developing countries, where the prevalence of the disease is high and the resources for its control are limited. It is also a threat for the conservation of wildlife species that are reservoirs or spillover hosts of the infection (WOAH, 2023). This is because the infected wildlife species can maintain and transmit the infection to other animals, including livestock. This poses a threat for the conservation of wildlife, as bovine tuberculosis can cause mortality, morbidity, reduced reproduction, and population decline in affected species.

2.2 Cases of bovine tuberculosis worldwide

According to the World Organisation for Animal Health (WOAH, 2023), bTB is found throughout the world, but the disease is more prevalent in most parts of Africa, parts of Asia and of the Americas. Many developed countries, such as Denmark, Finland and Switzerland, have reduced or eliminated bTB from their cattle population (WOAH, 2023); however, significant pockets of infection remain in wildlife in Canada, the United Kingdom, the United States and New Zealand (Byrne et al., 2019). From January 2017 to June 2018, of the 188 countries and territories reporting their bTB situation to the WOAH, 82 countries (44%) were affected, which demonstrates a widespread distribution of the disease.

The control and eradication of bTB is challenging due to the complex epidemiology of the disease, the difficulty in diagnosing the infection, the lengthy incubation period (the average estimated incubation period of bTB in cattle is around 18 months), the lack of effective vaccines, and the negative impacts on economy and society (Palmer et al., 2023). In order to combat bTB, the WOAH advises a comprehensive strategy that includes surveillance, testing, culling, compensation, biosecurity, and public awareness to combat bTB. The WOAH also collaborates with other international organizations, such as the World Health Organization (WHO) and the Food and Agriculture Organization (FAO) to address the human and animal health aspects of bTB.

2.3 Cases of bovine tuberculosis in Malaysia

The Department of Veterinary Services (DVS) of Malaysia has issued a protocol for the prevention, control and eradication of bTB in cattle, buffalo, goats, sheep and deer. The protocol

includes veterinary standards, surveillance, testing, culling, compensation, biosecurity, and public awareness measures in Protokol Veterinar TB: PVM2(5):1/2011 (DVS, 2011).

The World Organisation for Animal Health (WOAH) reports that Malaysia has not notified any outbreaks of bTB to the WOAH since 2005. However, this does not necessarily mean that the disease is absent or under control in the country, as there may be under-reporting or lack of diagnostic capacity.

2.4 Challenges of eradicating bovine tuberculosis from the industry

The control and eradication of bTB is challenging due to the complex epidemiology of the disease, difficulties in diagnosing the infection, long incubation period, lack of effective vaccines, and economic and social impacts of the disease. WOAH recommends a comprehensive approach that involves surveillance, testing, culling, compensation, biosecurity, and public awareness to combat bTB. WOAH also collaborates with other international organizations, such as the World Health Organization (WHO) and the Food and Agriculture Organization (FAO), to address the human and animal health aspects of bTB.

3.0 Methodology

3.1 Study population

Inclusion criteria: This survey should be participated only for all dairy cattle farmers and workers aged 18 years old above that reside in Selangor and have Malaysian citizenship.

Exclusion criteria: Dairy cattle farmers, workers and any other participants under 18 years old and those who do not have Malaysian citizenship should not participate in this study.

Sample size calculation: By using finite population correction for proportions formula and using a 5% margin of error at a 95% confidence interval and 50% prevalence of bTB, the total sample size i.e., respondents required for this study was 120.

$$n_0 = \frac{(z_{1-\alpha/2})^2 * p(1-p)}{d^2} \dots \dots \text{If } N \geq 10,000$$

where, P: Estimated population proportion, P=0.5

Z_{0.975}= 1.96 (i.e., Z or at 95% CI) or

$$(z_{1-\alpha/2})^2 = 3.84 \dots \dots \alpha = 0.05$$

N: Study population, N = 174

d: Margin of error, d=0.05

q=1-p=0.5

n₀: number of sample unit to be studied

$$n_0 = \frac{(z_{1-\alpha/2})^2 * p(1-p)}{d^2} = \frac{(z_{1-0.05/2})^2 * 0.5(1-0.5)}{0.05^2} = 384$$

Since N is <10,000, correction formula can be used to determine the final sample size i.e.

where, nf = final sample unit to be studied = initial sample, N = study population

$$nf = \frac{n_0}{1 + \left(\frac{n_0}{N}\right)} = \frac{384}{1 + \left(\frac{384}{174}\right)} = \approx 120$$

3.2 Human Ethics Approval

This research project has been approved by the Ethics Committee for Research Involving Human Subjects (JKEUPM) – JKEUPM-2023-484. Furthermore, the information obtained from this study was kept private and confidential. All respondents were notified that they were giving informed consent for their data to be used for research by taking the survey.

3.3 Questionnaire Design

This questionnaire was created from original insights after extensive research on the bovine tuberculosis disease. The questionnaire was designed to obtain respondent's sociodemographic profile, knowledge, attitudes and practices of dairy cattle farmers towards bovine tuberculosis. There were a total of 4 sections, which were sociodemographic section (10 questions), knowledge section (14 questions), attitudes section (10 questions) and practices section (9

questions). The questionnaire was in dual languages- Bahasa Malaysia and English with multiple choice questions and close-ended questions.

3.4 Study Design

This is a cross sectional study utilising questionnaire survey based on voluntary participation of respondents conducted from 28 August to 2 October 2023 (5 weeks). Farmers were first contacted by phone calls to obtain their consent to become respondents. Then, data collection was performed by online and offline via the Google Forms, phone call interviews and farm visits.

3.5 Statistical Analysis

Collected data were checked for inconsistencies and eligibility issues and were recorded in Excel and exported to IBM SPSS version 27.0 for cross-checking and analysis, respectively. Descriptive statistics were used to summarize the responses to the questionnaire. During the assessment, the frequencies of various variables were calculated and then compared using cross-tabulation. Modified Bloom's cut-off point was used to assess the overall knowledge, attitude, and practices of the respondents. There were 14, 10, and 9 questions to assess knowledge, attitude, and practices, respectively. Respondents who answered towards positive knowledge will be given 2 marks and 1 mark for neutral/not sure, 0 towards negative knowledge or wrong answer. This was also applied to the scoring of attitudes and practices. The overall score was reported in the form of a percentage. KAP scores were reported as mean \pm standard deviation (SD). Respondents who obtained overall score 80% and more for correct answers were classified as having good KAP; those with a range of 60% to 79% were considered to have

moderate KAP, while those with marks less than 59% were regarded as having poor KAP. The association between demographic characteristics and KAP scores was tested by chi-square test with $P < 0.05$ as the significant level. The Fisher-Freeman-Halton exact test $p\text{-value} < 0.05$ was used where necessary.



4.0 Results

4.1 Sociodemographic of the respondents and animals-related information

Initially, 100 dairy cattle farmers were successfully contacted and 88 of them agreed to take part in the survey study, however, only a total of 21 respondents participated in this survey throughout the course of this 5-week study period. Most of the respondents were between the ages of 45 and 54 years old, which was 33.3% (n=7), 28.57% (n=6) were between 35 and 44 years old, 19.05% (n=4) were between 25 and 34 years old, 9.52% (n=2) were between 55 and 64 years old and 9.52% (n=2) were between 18 and 24 years old (Table 1).

For education, the highest education level among respondents were secondary education which was 57.14% (n=12), while 33.3% (n=7) had tertiary education, which included 9.52% (n=2) vocational graduates, 4.76% (n=1) diploma graduate, 14.29% (n=3) bachelor's degree holders and 4.76% (n=1) master's degree holder, the other 9.52% (n=2) had education until primary school (Table 1).

At the farm level information, the majority of the farmers owned animals of imported breeds (61.9%, n=13) meanwhile the rest, owned animals of local breeds 38.1% (n=8). One-third of the farmers (n=7) had imported animals on their farms. The cattle were reared for several purposes. Most of the farmers (52.38%, n=11) reared their animals for milk purpose, 4.76% (n=1) reared animals for meat purpose and 42.86% (n=9) reared animals for both milk and meat purpose. For herd size, most farmers (71.43%, n=15) had a herd size of more than 20 animals, 14.29% of them (n=3) had a herd size between 10 to 20 animals and 14.29% of them (n=3) had a herd size of less than 10 animals (Table 1).

For the farm management system, many farmers (57.14%, n=12) practiced a semi-intensive management system, 23.81% of them (n=5) practiced free grazing management systems and 19.05% of them (n=4) practiced intensive management systems (Table 1).

Most of the farmers (61.9%, n=13) had other animals on their farms and 38.1% of them (n=8) only had dairy cattle on their farms (Table 1).

Table 1 : Sociodemographic information of dairy cattle farmers in Selangor. (28/8/2023-2/10/2023, N=21)

Demographic characteristics	Options	%, n
1. Education level	Primary	9.52%, 2
	Secondary	57.14%, 12
	Vocational	9.52%, 2
	Diploma	4.76%, 1
	Bachelor	14.29%, 3
	Master	4.76%, 1
	2. Citizenship	Malaysian
Non-Malaysian		-
3. Age of farmer	18-24 years old	9.52%, 2
	25-34 years old	19.05%, 4
	35-44 years old	28.57%, 6
	45-54 years old	33.3%, 7
	55-64 years old	9.52%, 2
4. Breed	Local	38.1%, 8
	Imported	61.9%, 13
5. Import animals or not	Yes	33.3%, 7

	No	66.67%, 14
6. Purpose	Milk	52.38%, 11
	Meat	4.76%, 1
	Milk and Meat	42.86%, 9
7. Herd size	<10	14.29%, 3
	10 – 20	14.29%, 3
	>20	71.43%, 15
8. Management	Free grazing	23.81%, 5
	Intensive	19.05%, 4
	Semi-intensive	57.14%, 12
9. Other animals	Yes	61.9%, 13
	No	38.1%, 8

4.2 Knowledge of respondents towards bovine tuberculosis

In the knowledge section, there were a total of 14 questions, the farmers were assessed on their understandings on various aspects of bovine tuberculosis, which included the mode of transmission, clinical signs, prevention measures and diagnostic methods. Majority of the farmers (76.19%, n=16) had heard about bovine tuberculosis in cattle and the other 23.81% (n=5) had never heard about bovine tuberculosis. For the awareness of the zoonotic potential of bovine tuberculosis, 9.52% (n=2) of the farmers thought that they had a great deal of knowledge, 19.05% (n=4) of the farmers thought that they knew quite a bit, 14.29% (n=3) somewhat knew, 23.81% (n=5) knew a little bit and 33.33% (n=7) of the farmers did not know at all about the zoonotic potential of bovine tuberculosis. For the cause of bovine tuberculosis in cattle, majority

of the farmers (57.24%, n=12) were able to identify microorganism as the cause, 4.76% (n=1) thought bad weather causes bovine tuberculosis and 38.1% of the farmers (n=8) did not have idea. In terms of transmission of bovine tuberculosis, 9.52% (n=2) of the farmers thought that they knew a great deal, (9.52%, n=2) knew quite a bit, (9.52%, n=2) knew some, (42.86%, n=9) knew only a little bit and (28.57%, n=6) did not have any idea about the transmission of bovine tuberculosis. When the farmers were asked to identify the transmission routes of bovine tuberculosis between cattles from a list of choices, 28.57% (n=6) were able to identify all of the routes correctly, 61.9% (n=13) were able to identify at least one transmission route correctly and 9.52% (n=2) did not know about any transmission route of bovine tuberculosis (Table 2).

For the signs and symptoms of bovine tuberculosis in cattle, 9.52% (n=2) of the farmers thought that they knew a great deal, (9.52%, n=2) knew quite a bit, (33.33%, n=7) knew some, (42.86%, n=9) only knew a little bit and (4.76%, n=1) did not have any idea. When asked to identify the clinical signs of animals infected with bovine tuberculosis from a list of choices, only 23.81% (n=5) of the farmers were able to identify all the correct clinical signs correctly, (66.66%, n=14) were able to identify at least one clinical sign correctly and (9.52%, n=2) did not have any idea (Table 2).

Majority of farmers (71.43%, n=15) knew that bovine tuberculosis is preventable on farms while the other 28.57% (n=6) did not know (Table 2).

In terms of risk factors associated with bovine tuberculosis, 4.76% (n=1) of the farmers thought that he is extremely knowledgeable about the risk factors of bovine tuberculosis, (4.76%, n=1) was very knowledgeable, (33.33%, n=7) were moderately knowledgeable, (42.86%, n=9) were slightly knowledgeable and (14.29%, n=3) were not knowledgeable at all. However, when asked

to identify the risk factors for bovine tuberculosis in dairy cattle, all the farmers were able to answer correctly (Table 2).

When asked to identify the preventive measures of bovine tuberculosis on farms from a list of choices, it was found that none of the farmers were able to identify all of them correctly. However, the majority of the farmers (61.9%, n=13) had identified “Cull infected cattle” as one of their answers to this survey question. All the farmers were able to identify at least one preventive measure correctly (Table 2).

For the diagnostic test available for bovine tuberculosis in cattle, majority of the farmers (52.38%, n=11) were not aware of any diagnostic tests available for this disease, (9.52%, n=2) were aware and quite familiar with the diagnostic tests available, (14.29%, n=3) were aware and somewhat familiar with the diagnostic tests available and (23.81%, n=5) were aware but not familiar with the diagnostic tests available (Table 2).

About the measures that can be taken to reduce the risk of transmission of bovine tuberculosis from wildlife to cattle, (4.76%, n=1) of the farmers thought that he knew a great deal, (14.29%, n=3) knew quite a bit, (19.05%, n=4) somewhat knew, (33.33%, n=7) knew a little bit and (28.57%, n=6) did not know at all (Table 2).

In terms of regulations and guidelines for controlling bovine tuberculosis in the country, 9.52% (n=2) of the farmers thought that they were extremely familiar with them, (4.76%, n=1) was very familiar, (28.57%, n=6) were moderately familiar, (38.1%, n=8) were slightly familiar and (19.05%, n=4) were not familiar at all (Table 2).

Table 2 : Knowledge of dairy cattle farmers in Selangor towards bovine tuberculosis. (28/8/2023-2/10/2023, N=21)

Questions	Options	%, n
1. Have you heard about bovine tuberculosis in cattle?	Yes	76.19%, 16
	No	23.81%, 5
2. Do you know the zoonotic potential of bovine tuberculosis?	Not at all	33.33%, 7
	A little bit	23.81%, 5
	Somewhat	14.29%, 3
	Quite a bit	19.05%, 4
	A great deal	9.52%, 2
3. What do you think is the cause of tuberculosis in cattle?	Bad weather	4.76%, 1
	Microorganism	57.14%, 12
	Do not know	38.1%, 8
4. How much do you know about the transmission of bovine tuberculosis?	Nothing at all	28.57%, 6
	A little bit	42.86%, 9
	Some	9.52%, 2
	Quite a bit	9.52%, 2
	A great deal	9.52%, 2
5. The disease can be transmitted from one cattle to another cattle through? (can choose more than one answer)	Inhalation of the droplets from coughing	38.1%, 8
	Ingestion of unpasteurised milk	14.29%, 3
	Touch of the sick animals	19.05%, 4
	Do not know	9.52%, 2
6. How much do you know about the signs and	Nothing at all	4.76%, 1

symptoms of bovine tuberculosis in cattle?		
	A little bit	42.86%, 9
	Some	33.33%, 7
	Quite a bit	9.52%, 2
	A great deal	9.52%, 2
7. What are the clinical signs of animals infected with tuberculosis? (can choose more than one answer)	Coughing	76.19%, 16
	Weight loss	76.19%, 16
	Diarrhea	28.57%, 6
	Inappetence	71.43%, 15
	Do not know	9.52%, 2
8. Do you know that bovine tuberculosis is preventable on farms?	Yes	71.43%, 15
	No	28.57%, 6
9. How knowledgeable are you about the risk factors associated with bovine tuberculosis transmission?	Not knowledgeable at all	14.29%, 3
	Slightly knowledgeable	42.86%, 9
	Moderately knowledgeable	33.33%, 7
	Very knowledgeable	4.76%, 1
	Extremely knowledgeable	4.76%, 1
10. Which of the following is a risk factor for bovine tuberculosis in dairy cattle?	Overcrowding in the barn	100%, 21
	Regular cleaning and disinfection of barn and equipment	-

	Adequate ventilation in the barn	-
	Providing clean and fresh water to the cattle	-
	Do not know	-
11. What method can be used to prevent bovine tuberculosis on farms? (can choose more than one answer)	Maintain closed herd	19.05%, 4
	Cull infected cattle	61.9%, 13
	Ask about test history of purchased animals	52.38%, 11
	Isolate animals after purchase and carry out tuberculin test	61.9%, 13
	Bottle-fed the calves	19.05%, 4
	Do not know	-
12. Are you aware of any diagnostic tests available for bovine tuberculosis in cattle?	No	52.38%, 11
	Yes, but I am not familiar with them	23.81%, 5
	Yes, I am somewhat familiar with them	14.29%, 3
	Yes, I am quite familiar with them	9.52%, 2
	Yes, I am very familiar with them	-
13. Do you know what measures can be taken to reduce the risk of transmission of bovine tuberculosis from wildlife to cattle?	Not at all	28.57%, 6
	A little bit	33.33%, 7
	Somewhat	19.05%, 4

	Quite a bit	14.29%, 3
	A great deal	4.76%, 1
14. How familiar are you with the regulations and guidelines for controlling bovine tuberculosis in your country?	Not familiar at all	19.05%, 4
	Slightly familiar	38.1%, 8
	Moderately familiar	28.57%, 6
	Very familiar	4.76%, 1
	Extremely familiar	9.52%, 2

4.3 Attitudes of respondents towards bovine tuberculosis

In the attitudes section, there were a total of 10 questions, and the questions mainly aimed to find out the farmer's perspective on bovine tuberculosis as a threat to the dairy industry. Most of the farmers (61.9%, n=13) agreed that bovine tuberculosis is a serious problem for the dairy industry, (14.29%, n=3) even strongly agreed with this, (14.29%, n=3) remained neutral and (9.52%, n=2) disagreed that bovine tuberculosis is a serious problem for the dairy industry. Besides, majority of the farmers (61.9%, n=13) agreed that it is important to control bovine tuberculosis in their herd, (23.81%, n=5) even strongly agreed with this, (9.52%, n=2) remained neutral on this and (4.76%, n=1) strongly disagreed that it is important to control bovine tuberculosis in his herd (Table 3).

About milk pasteurization, 47.62% (n=10) of the farmers agreed that unpasteurised milk from suspected animals should be avoided, (23.81%, n=5) even strongly agreed with this, (19.05%,

n=4) remained neutral on this and (9.52%, n=2) disagreed that unpasteurised milk from suspect animals should be avoided (Table 3).

Regarding the sources of animals, majority of the farmers (47.62%, n=10) strongly agreed that it is important to purchase animals from reliable sources, (42.86%, n=9) agree, (4.76%, n=1) remained neutral and (4.76%, n=1) strongly disagree that it is important to purchase animals from reliable sources (Table 3).

For the culling of infected animals, majority of farmers (57.14%, n=12) disagreed that culling of infected animals is costly and therefore not necessary, (19.05%, n=4) remained neutral and (23.81%, n=5) agreed that it is not necessary to cull infected animals as it is costly (Table 3).

When asked whether they seek professional advice if the farmers find that there are suspected cases of bovine tuberculosis on farm, almost all the farmers (90.48%, n=19) expressed the will to seek professional advice from the Department of Veterinary Services of Malaysia, (4.76%, n=1) will seek professional advice from private veterinarian and (4.76%, n=1) will not seek any professional advice (Table 3).

Majority of the farmers (66.67%, n=14) agreed that bovine tuberculosis can be eradicated from the dairy industry, (23.81%, n=5) remained neutral and (9.52%, n=2) disagreed that bovine tuberculosis can be eradicated from the dairy industry (Table 3).

Majority of the farmers (76.19%, n=16) agreed that farmers should be held responsible for controlling the spread of bovine tuberculosis on their farms, (19.05%, n=4) remained neutral on this and (4.76%, n=1) disagreed that farmers should be held responsible for controlling the spread of bovine tuberculosis on their farms (Table 3).

In general, all of the farmers were concerned about the potential impact of bovine tuberculosis on their herd productivity and profitability, (19.05%, n=4) were extremely concerned, (47.62%,

n=10) were very concerned, (28.57%, n=6) were moderately concerned and (4.76%, n=1) were slightly concerned (Table 3).

When asked whether they believe that the government should provide financial incentives for farmers to control bovine tuberculosis on their farms, majority of the farmers (80.95%, n=17) agreed, (9.52%, n=2) remained neutral and (9.52%, n=2) disagreed with this suggestion (Table 3).

Table 3 : Attitudes of dairy cattle farmers in Selangor towards bovine tuberculosis. (28/8/2023-2/10/2023, N=21)

Questions	Options	%, n
1. Do you believe that bovine tuberculosis is a serious problem for the dairy industry?	Strongly disagree	-
	Disagree	9.52%, 2
	Neither agree nor disagree	14.29%, 3
	Agree	61.9%, 13
	Strongly agree	14.29%, 3
2. Do you believe that it is important to control bovine tuberculosis in your herd?	Strongly disagree	4.76%, 1
	Disagree	-
	Neither agree nor disagree	9.52%, 2
	Agree	61.9%, 13
	Strongly agree	23.81%, 5
3. Do you think unpasteurised milk from suspect animals should be avoided?	Strongly disagree	-
	Disagree	9.52%, 2

	Neither agree nor disagree	19.05%, 4
	Agree	47.62%, 10
	Strongly agree	23.81%, 5
4. Do you think it is important to purchase animals from reliable sources?	Strongly disagree	4.76%, 1
	Disagree	-
	Neither agree nor disagree	4.76%, 1
	Agree	42.86%, 9
	Strongly agree	47.62%, 10
5. Do you think culling of infected animals is costly and therefore not necessary?	Strongly disagree	28.57%, 6
	Disagree	28.57%, 6
	Neither agree nor disagree	19.05%, 4
	Agree	23.81%, 5
	Strongly agree	-
6. Do you seek professional advice if you find that there are suspected cases of bovine tuberculosis on a farm?	Yes, I seek professional advice from DVS, Malaysia.	90.48%, 19
	Yes, I seek professional advice from a private veterinarian.	4.76%, 1
	No	4.76%, 1
7. Do you believe that bovine tuberculosis can be eradicated from the dairy industry?	Strongly disagree	4.76%, 1
	Disagree	4.76%, 1
	Neither agree nor disagree	23.81%, 5

	Agree	61.9%, 13
	Strongly agree	4.76%, 1
8. Do you think that farmers should be held responsible for controlling the spread of bovine tuberculosis on their farms?	Strongly disagree	-
	Disagree	4.76%, 1
	Neither agree nor disagree	19.05%, 4
	Agree	57.14%, 12
	Strongly agree	19.05%, 4
9. How concerned are you about the potential impact of bovine tuberculosis on your herd's productivity and profitability?	Not at all concerned	-
	Slightly concerned	4.76%, 1
	Moderately concerned	28.57%, 6
	Very concerned	47.62%, 10
	Extremely concerned	19.05%, 4
10. Do you believe that the government should provide financial incentives for farmers to control bovine tuberculosis on their farms?	Strongly disagree	-
	Disagree	9.52%, 2
	Neither agree nor disagree	9.52%, 2
	Agree	52.38%, 11
	Strongly agree	28.57%, 6

4.4 Practices of respondents towards bovine tuberculosis

Results for the practices section of the questionnaire were presented in Table 4. There were 9 questions mainly aimed to find out how the farmers would perceive in playing a role in the prevention and control of bovine tuberculosis. Most of the farmers (52.38%, n=11) did not routinely isolate and test new cattles for bovine tuberculosis before introducing them to the herd, the others (47.62%, n=10) did routinely isolate and test new cattles for bovine tuberculosis for at least 30 days before introducing them to the herd.

While for the records of cattle's bovine tuberculosis test results, most of the farmers (38.1%, n=8) did not keep them. Among the other farmers (61.9%, n=13) that kept the records, (19.05%, n=4) reviewed them frequently, (9.52%, n=2) reviewed them regularly, (23.81%, n=5) reviewed them occasionally and the others (9.52%, n=2) did not review them regularly.

When the farmers were asked how would they dispose of the animals if tested positive for bovine tuberculosis, majority of them (71.43%, n=15) expressed that they will euthanize the animals, (19.05%, n=4) said they will quarantine the animals, (4.76%, n=1) said he will let DVS to dispose of the animals and (4.76%, n=1) did not have any idea.

For the cleaning and disinfection of farm equipment and facilities, majority of the farmers (52.38%, n=11) did it regularly to prevent the spread of disease, (42.86%, n=9) always do it and (4.76%, n=1) did the cleaning and disinfection occasionally. While for the disinfectant used on cattle shed and farm equipments, majority of the farmers (61.9%, n=13) used Lindores, (4.76%, n=1) used Clorox, (4.76%, n=1) used soap, (4.76%, n=1) used turmeric powder, (4.76%, n=1) used antibacterial agent, the others (19.05%, n=4) did not disclose the type of disinfectant they used.

Majority of the farmers' cattle (61.9%, n=13) were reliant on natural water sources, such as ponds, rivers and wells.

Majority of the farmers' cattle grazing fields (90.48%, n=19) were not shared with neighboring animal herds.

When the farmers were asked how often did they consult a veterinarian to ask about bovine tuberculosis prevention and control measures, majority of the farmers (33.33%, n=7) said that they consulted regularly, (14.29%, n=3) consulted always, (14.29%, n=3) consulted occasionally, (9.52%, n=2) consulted rarely and (28.57%, n=6) had never consulted.

All the farmers (100%, n=21) said that they will go to hospital or clinic if they were infected with tuberculosis.

Table 4 : Practices of dairy cattle farmers in Selangor towards bovine tuberculosis. (28/8/2023-2/10/2023, N=21)

Questions	Options	%, n
1. Do you routinely isolate and test new cattles for bovine tuberculosis before introducing them to your herd?	Yes, for 30 days	33.33%, 7
	Yes, for 40 days	9.52%, 2
	Yes, for 50 days	-
	Yes, for 60 days	4.76%, 1
	No	52.38%, 11
2. Do you keep records of your cattle's bovine tuberculosis test results?	No	38.1%, 8

	Yes, but I don't review them regularly.	9.52%, 2
	Yes, I review them occasionally.	23.81%, 5
	Yes, I review them regularly.	9.52%, 2
	Yes, I review them frequently.	19.05%, 4
3. How do you dispose of cattle that test positive for bovine tuberculosis? State if there is other way.	Sell them for slaughter	-
	Euthanize them	61.9%, 13
	Quarantine them	19.05%, 4
	Other: Quarantine and euthanize	4.76%, 1
	Other: Euthanize and bury	4.76%, 1
	Other: No experience	4.76%, 1
	Other: Let DVS dispose of the animals	4.76%, 1
4. How often do you clean and disinfect equipment and facilities to prevent the spread of disease?	Never	-
	Rarely	-
	Occasionally	4.76%, 1
	Regularly	52.38%, 11
	Always	42.86%, 9
5. Is the cattle shed and equipment cleaned and disinfected after each use? If yes, state	Yes	19.05%, 4

the disinfectant.		
	Yes, Lindores	61.9%, 13
	Yes, Clorox	4.76%, 1
	Yes, soap	4.76%, 1
	Yes, antibacterial	4.76%, 1
	Yes, turmeric powder	4.76%, 1
6. Are your cattle reliant on natural water sources, such as ponds, rivers and wells?	Yes	61.9%, 13
	No	38.1%, 8
7. Is the grazing field shared with any neighboring animal herds?	Yes	9.52%, 2
	No	90.48%, 19
8. How often do you consult with a veterinarian about bovine tuberculosis prevention and control measures?	Never	28.57%, 6
	Rarely	9.52%, 2
	Occasionally	14.29%, 3
	Regularly	33.33%, 7
	Always	14.29%, 3
9. What would you do if you were infected with tuberculosis?	Go to hospital or clinic	100%, 21
	Go to pharmacy	-
	Go to traditional healer	-

4.5 The level of knowledge, attitude and practices of dairy cattle farmers in Selangor towards bovine tuberculosis

Overall, the dairy farmers of Selangor had poor knowledge regarding bovine tuberculosis as only 14.28% of them (3/21) had good scores for knowledge section and 61.9% of them (13/21) had poor scores for knowledge section. The dairy farmers of Selangor had a good attitude towards bovine tuberculosis overall, with 57.14% of them (12/21) scoring good for the attitude section and only 9.52% of them (2/21) having poor scores for the attitude section. Besides, it was also shown that the dairy farmers of Selangor had moderate practice towards bovine tuberculosis, with 28.57% of them (6/21) having good scores for practice section, 42.86% of them (9/21) having moderate scores for practice section and 28.57% of them (6/21) having poor scores for practice section (Table 5).

Based on the Modified Bloom Cut-Off point, 3/21 of dairy cattle farmers (14.29%) had good KAP scores, 10/21 of them (47.62%) had moderate KAP scores and 8/21 of them (38.1%) had poor KAP scores. Overall, the dairy cattle farmers of Selangor had moderate KAP scores.

The farmers obtained a mean (\pm SD) knowledge, attitude, and practice scores of 15.05 ± 5.66 , 15.43 ± 2.44 , 12.76 ± 2.84 out of 28, 20 and 18 possible scores, respectively (Table 5).

Table 5 : The level of knowledge, attitude and practice of dairy cattle farmers in Selangor towards bovine tuberculosis. (28/8/2023-2/10/2023, N=21)

Level	Total score	N (%)		Mean score	Standard Deviation
Knowledge	Poor	13	61.90%	15.05	5.66
	Moderate	5	23.81%		
	Good	3	14.28%		
Attitudes	Poor	2	9.52%	15.43	2.44
	Moderate	7	33.33%		
	Good	12	57.14%		
Practices	Poor	6	28.57%	12.76	2.84
	Moderate	9	42.86%		
	Good	6	28.57%		

4.6 Factors associated with the level of KAP on bovine tuberculosis among dairy cattle farmers

There was no significant association between demographic characteristics and KAP scores ($P > 0.05$) except for the presence of imported animals on farms ($P < 0.05$). There was significant association between the presence of imported animals on farms and KAP scores (Fischer-Freeman-Halton exact test p -value = 0.044) as shown in Table 6.

Table 6 : Factors associated with the level of knowledge, attitudes and practices on bovine tuberculosis among dairy cattle farmers. (28/8/2023-2/10/2023, N=21)

Factors	The level of knowledge, attitudes and practices
Education level	0.203
Age	0.674
Breed	0.413
Presence of Imported Animals	0.044*
Purpose	0.745
Herd size	0.628
Management	0.515
Other animals	0.188

*Significant at P-value < 0.05

5.0 Discussion

In Malaysia, bTB is a major problem for the dairy industry, especially in urban and peri-urban areas where exotic breeds and their crosses are kept under intensive production systems (WHO, 2022). Bovine tuberculosis has caused public health risk and economic losses to the dairy cattle farmers. Due to the big impact of bovine tuberculosis, it is important that the eradication program of bovine tuberculosis is carried out across the country. This study is the first attempt to assess the knowledge, attitude and practices (KAP) of dairy cattle farmers regarding bovine tuberculosis in the Malaysian context. The predictors of overall KAP among the respondents were also investigated.

From the sociodemographic background of the participating dairy cattle farmers, each possible predictors of their KAP towards bovine tuberculosis have been studied. Among the most relevant predictors include education level, presence of imported animals on farm, herd size and management system of the farms.

It has been found that only one third of the respondents had tertiary education, and most of the farmers that had good KAP scores towards bovine tuberculosis were from this category. From this study, the farmers with good KAP scores were mostly from Bachelor and Master education level, and this made up two third of all good KAP scorers in this study. Possible correlation

between education level and KAP towards bovine tuberculosis could be inferred here. A similar study in Bangladesh that studied the knowledge and attitude of farmers of small-scale dairy farming showed that education level of farmers was positively correlated with their knowledge and attitude towards dairy farming (Rahman et al., 2021). Another paper that studied the knowledge, attitudes and practices of dairy farmers towards brucellosis surveillance and control programs in Bogor, Indonesia also revealed that formal education is among variables that had direct and significant impact on farmers' practice of brucellosis surveillance and control (Kustiningsih et al., 2023).

The farmers that imported dairy cattle made up one third of the total respondents, and all the good KAP scorers were from this category of farmers. This group of farmers also had a lower percentage of poor KAP scorers when compared to those farmers that did not import dairy cattle. Apparently, the presence of imported animals on farms are correlated with the KAP of farmers towards bovine tuberculosis, and these farmers could have been trained and instilled with the awareness regarding disease management by exporters or authorities. This was supported by one similar research that studied the knowledge, attitudes and practices of dairy farmers in Punjab, Pakistan towards bovine tuberculosis which showed that the presence of imported animals on farm was positively associated with better knowledge and practices scores towards bovine tuberculosis, suggesting that farmers who buy animals from abroad may have more contact and collaboration with veterinarian and other stakeholders, who can provide them with information and guidance on bovine tuberculosis (Ali et al., 2015).

Most of the dairy cattle farmers (71.43%) in this study had a big herd size, and at the same time all the good KAP scorers were having a big herd size. Only a small percentage of farmers having big herd size had poor KAP scores towards bTB. The herd size of dairy cattle on farms could possibly be positively correlated with the KAP of farmers, which could be due to the chances of farmers to accumulate more experience and knowledge when they deal with larger amounts of farm animals. According to Rahman et al. (2021), the knowledge and attitudes of farmers of small-scale dairy farming in Bangladesh, it was found that the herd size was positively correlated with the knowledge and attitudes scores of farmers, meaning that farmers with larger herd size had better knowledge and attitudes towards dairy farming. This paper also suggested that increasing the herd size of the small-scale dairy farmers can improve their knowledge and attitudes towards dairy farming, as well as their productivity and profitability. These findings were parallel to this study of KAP of dairy cattle farmers in Selangor where farmers with big herd size had better KAP scores towards bTB.

Semi-intensive management system was found to be the most practiced farm management system by dairy cattle farmers in Selangor. In this study, the category of farmers that practiced a semi-intensive management system had shown to have a higher percentage of good KAP scorers than the other types of farm management system, which are intensive and extensive management systems. This finding hinted that a semi-intensive management system could have helped dairy cattle farmers to understand the animals better through close observation and interaction with their farm animals, which made this management system a more mainstream farm management system among dairy cattle farmers in Selangor. This agrees with a similar study on the knowledge, attitudes and practices of smallholder cattle farmers concerning the epidemiology of

bovine fasciolosis in the Northwest Province, South Africa (Olaogun et al., 2023), which showed that cattle farmers that practice semi-intensive management systems ($p < 0.001$) were associated with positive practice scores concerning bovine fasciolosis prevention. This study found that farmers engaging in semi-intensive management systems were possibly more likely to seek education and intervention from veterinary personnel, and this could be the reason for improved practices for prevention of zoonotic diseases.

Most of the respondents (76.2%) were aware of the existence of bovine tuberculosis (bTB). It is likely that most of the respondents had heard of the term 'tuberculosis' before but in the form of the human-infection type, which is human tuberculosis. Previous outbreak of human tuberculosis in Malaysia in the past could have made tuberculosis and its symptoms well-known (WHO, 2022). Nevertheless, only a low percentage of them (14.3%) had satisfactory knowledge scores about bovine tuberculosis. Also, the mean scores for the knowledge section (15.05 out of 28 total scores), by using Modified Bloom Cut-off Point as reference, showed that the farmers had poor knowledge regarding bovine tuberculosis. This finding agreed with a similar study by Sadiq et al. (2021), which studied the knowledge, attitude and practices of ruminant farmers in Selangor towards zoonotic diseases. According to Sadiq et al. (2021), only 17.8% of ruminant farmers in Selangor were aware of tuberculosis. After all, the poor knowledge of dairy cattle farmers in Selangor towards bovine tuberculosis was reflected on the education background of the farmers, as only 30% of the farmers had tertiary education. From here, the importance of the education background of farmers could possibly be inferred, as the poor education background of most farmers that participated in this study might have limited understanding on bovine tuberculosis. It was also prevailed that most of the farmers had shown to have poor understanding on the mode

of transmission of bTB, the important clinical signs and the field detection of bTB. This is detrimental to the dairy farming practice as it will lead these farmers to carry out wrong practices, including selling unpasteurized milk from infected cattle to the public, which may cause public health issues. One study conducted in the United States by Lejeune et al. (2009) concluded that unpasteurised milk consumption poses serious public health threats, including increased incidence of outbreaks and sporadic cases of milk-borne diseases. Moreover, the poor practice of dairy cattle farmers towards bovine tuberculosis prevention may bring upon huge economic losses. A paper that estimated the economic impact of bovine tuberculosis outbreaks on farmers in Spain revealed that the average loss per farm due to bovine tuberculosis was 11 000 euros, which represented 8.6% of the annual gross margin (Rosario et al., 2020). According to Rosario et al., these losses were mainly caused by the culling of bovine tuberculosis infected animals, the replacement of the culled animals and the immobilization of the rest of the herd. One study in India showed that the knowledge and the adoption of good management practice by the dairy cattle farmers is positively correlated (Mali et al., 2014). From this present study, it was found that none of the farmers can completely identify all the 5 methods that can be used to prevent bovine tuberculosis on farms, which included maintaining closed herd, cull infected cattle, ask about test history of purchased animals, isolate animals after purchase and carry out tuberculin test and bottle feeding of calves. Moreover, most of the farmers were not aware of any diagnostic tests available for bovine tuberculosis in cattle. This significantly increases the odds of bovine tuberculosis outbreak on farms. Therefore, it is important that the knowledge of farmers towards bovine tuberculosis be increased, as with poor knowledge it is very unlikely that the farmers can carry out good practice towards bovine tuberculosis on their farms.

From this survey study, it was found that the farmers were aware of the seriousness of bovine tuberculosis in the dairy farming industry and believed that farmers should be responsible to eradicate this disease from the industry. Besides, most farmers agreed that infected animals should be culled instead of slaughtered for sale despite economic loss. In fact, the long term economic benefits from culling off bovine tuberculosis infected animals have been revealed in a research study done by Barlow et al., (1997). Moreover, almost all farmers (n=19) will seek professional advice if they find that there are suspected cases of bovine tuberculosis on their farms. This suggests that the farmers exhibited earnest attitudes and put in effort to communicate with professionals while dealing with bovine tuberculosis disease. Ciaravino et al. (2017) described that studied farmers and veterinarians' attitude towards bovine tuberculosis eradication programme in Spain, revealed that the complexity of bovine tuberculosis epidemiology combined with knowledge gaps and weak communication throughout stakeholders contributed to causing disbeliefs, which in turn generated different kinds of guesses and interpretations. Despite having poor knowledge on bovine tuberculosis, dairy cattle farmers in Selangor are still putting in efforts in communication in which most of the farmers will seek professional advice if they find suspected cases of bovine tuberculosis in their farms. This is a positive attitude that could indicate the eagerness to have good practice and professionally be guided to eradicate bovine tuberculosis from the farm.

Interestingly, despite the poor knowledge of dairy cattle farmers in Selangor towards bovine tuberculosis, their overall KAP scores towards bovine tuberculosis were still moderate based on the reference to Modified Bloom Cut-off Point. The high mean scores of attitude towards bovine tuberculosis could have been the reason behind these results. Nevertheless, the knowledge of

farmers should be increased through various workshops and seminars that cover relevant aspects of bovine tuberculosis, such as clinical signs, transmission and risk factors. This is deemed important in order to assist the farmers with the correct understandings and optimal practices can easily be adopted by the farmers to eradicate bovine tuberculosis from the dairy cattle industry in the future.

From the findings of the association test, there is only one predictor found significantly associated with the knowledge, attitudes and practices of dairy cattle farmers in Selangor towards bovine tuberculosis, which is the presence of imported animals on farm (p -value =0.044). From these findings, it seemed that most of those relationships that were apparent from the results of this study, were in fact not significant enough to be taken into account, despite supported by similar research. Nevertheless, the small sample size of this present study needs to be viewed as a limitation that could have rendered this study less accurate and precise to represent the dairy cattle farmers of Selangor as a whole. This agreed with one study by Dhimal et al. (2014) that studied the knowledge, attitude and practice regarding dengue fever among the healthy population of highland and lowland communities in Central Nepal, which showed that the small sample size of the study may have limited the power and analysis, and some of the p -values may be unreliable. Dhimal et al. (2014) also pointed out that a larger and more representative sample would be required to confirm the findings of the study and to explore the possible interactions and compounding effects of the predictors on KAP.

In this study, the initial targeted population was 174 dairy cattle farmers that registered under the Department of Veterinary Services of Selangor, with only 100 of them successfully contacted

and only 21 of them completed the questionnaire. If the 100 dairy cattle farmers contacted were assumed to be the only active ones, then the rate of response would be only 21%. By using finite population correction for proportions formula and using a 5% margin of error at a 95% confidence interval, the total sample size was determined as 120. However, since the successfully contacted farmers were only 100, which was smaller than the proper sample size as calculated, all of them should take the survey to achieve the same level of accuracy and precision. In this study, the low response rate at 21% had significantly reduced the accuracy, precision and the representativeness of the sample studied. Therefore, the credibility of this study has been limited. To make this study more reliable, the geographical area studied should be increased so that the sampling bias could be reduced when more farmers join the survey. Besides, incentives could also be a way to encourage the dairy cattle farmers to join the study, as the voluntary mode of this study could have been the reason that the farmers became not interested in joining the survey.

6.0 Conclusion

This study revealed that the KAP levels on bTB among dairy cattle farmers in Selangor is moderate. Moreover, the sociodemographic factor that influences the KAP level of dairy cattle farmers in Selangor towards bTB is the presence of imported animals on farms.

7.0 Limitations and Recommendations

In this study, the small sample size ($n=21$) and low response rate (12.07%, 21 out of 174 farmers) could affect the internal and external validity of this study findings. For this study to be representative and not affected by outlier bias, the number of participants for this study should be at least 120 people. Therefore, this study has an issue with population representativeness. It is recommended to increase the geographical area of data collection and also to increase the period of survey so that more respondents can be reached, which will then improve the applicability of the study findings.

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9.0 Appendix

9.1 Questionnaire

Demographic Section	
1. What is your highest education level?	<ul style="list-style-type: none"> ● No schooling completed ● Nursery school to 8th grade ● Some high school, no diploma ● High school graduate, diploma or the equivalent ● Some college credit, no degree ● Trade/technical/vocational training ● Associate degree ● Bachelor's degree ● Master's degree ● Professional degree ● Doctorate degree
2. State your nationality:	<ul style="list-style-type: none"> ● Malaysia ● Non-Malaysia, state: _____
3. What is your age?	<ul style="list-style-type: none"> ● 18-24 years old ● 25-34 years old ● 35-44 years old ● 45-54 years old ● 55-64 years old ● 65-74 years old ● 75 years or older
4. What are the breeds of animals you own in the farm?	<ul style="list-style-type: none"> ● Local breed ● Crossed breed ● Imported breed
5. Are your cattle locally purchased or internationally purchased?	<ul style="list-style-type: none"> ● Locally purchased ● Internationally purchased
6. What is the main purpose of rearing the animals?	<ul style="list-style-type: none"> ● Milk ● Meat ● Milk and Meat
7. How big is the herd size of your farm animals?	<ul style="list-style-type: none"> ● < 10 ● 10–20 ● > 20
8. What type of management system does your farm apply?	<ul style="list-style-type: none"> ● Free grazing ● Intensive

	<ul style="list-style-type: none"> ● Semi-intensive
9. Are there any other animals in the farm as well?	<ul style="list-style-type: none"> ● No ● Yes, State: _____
Knowledge Section	
1. Have you heard about bovine tuberculosis/ tuberculosis in cattle?	<ul style="list-style-type: none"> ● Yes ● No
2. Do you know the zoonotic potential of bovine tuberculosis, i.e., the potential for transmission of the disease from animals to humans?	<ul style="list-style-type: none"> ● Not at all ● A little bit ● Somewhat ● Quite a bit ● A great deal
3. What do you think is the cause of tuberculosis in cattle?	<ul style="list-style-type: none"> ● Bad weather ● Microorganism ● Do not know
4. How much do you know about the transmission of bovine tuberculosis?	<ul style="list-style-type: none"> ● Nothing at all ● A little bit ● Some ● Quite a bit ● A great deal
5. The disease can be transmitted from one cattle to another cattle through? (can choose more than 1 answer)	<ul style="list-style-type: none"> ● Inhalation of the droplets from coughing ● Ingestion of unpasteurised milk ● Touch of the sick animals ● Do not know
6. How much do you know about the signs and symptoms of bovine tuberculosis in cattle?	<ul style="list-style-type: none"> ● Nothing at all ● A little bit ● Some ● Quite a bit ● A great deal
7. What are the clinical signs of animals infected with tuberculosis? (can choose more than 1 answer)	<ul style="list-style-type: none"> ● Coughing ● Weight Loss ● Diarrhea ● Inappetence ● Do not know
8. Do you know that bovine tuberculosis is preventable on farms?	<ul style="list-style-type: none"> ● Yes ● No

<p>9.How knowledgeable are you about the risk factors associated with bovine tuberculosis transmission?</p>	<ul style="list-style-type: none"> ● Not knowledgeable at all ● Slightly knowledgeable ● Moderately knowledgeable ● Very knowledgeable ● Extremely knowledgeable
<p>10.Which of the following is a risk factor for bovine tuberculosis in dairy cattle?</p>	<ul style="list-style-type: none"> ● Overcrowding in the barn ● Regular cleaning and disinfection of barn and equipment ● Adequate ventilation in the barn ● Providing clean and fresh water to the cattle
<p>11.What method can be used to prevent bovine tuberculosis on farms? (can choose more than 1 answer)</p>	<ul style="list-style-type: none"> ● Maintain closed herd ● Cull infected cattle ● Ask about test history of purchased animals Isolate animals after purchase and carry out tuberculin test ● Bottle-fed the calves ● Do not know
<p>12.Are you aware of any diagnostic tests available for bovine tuberculosis in cattle?</p>	<ul style="list-style-type: none"> ● No ● Yes, but I am not familiar with them ● Yes, I am somewhat familiar with them ● Yes, I am quite familiar with them ● Yes, I am very familiar with them
<p>13.Do you know what measures can be taken to reduce the risk of transmission of bovine tuberculosis from wildlife to cattle?</p>	<ul style="list-style-type: none"> ● Not at all ● A little bit ● Somewhat ● Quite a bit ● A great deal
<p>14.How familiar are you with the regulations and guidelines for controlling bovine tuberculosis in your country?</p>	<ul style="list-style-type: none"> ● Not at all familiar ● Slightly familiar ● Moderately familiar ● Very familiar ● Extremely familiar
<p>Attitudes Section</p>	
<p>1.Do you believe that bovine tuberculosis is a serious problem for the dairy industry?</p>	<ul style="list-style-type: none"> ● Strongly disagree ● Disagree ● Neither agree nor disagree ● Agree ● Strongly agree

2. Do you believe that it is important to control bovine tuberculosis in your herd?	<ul style="list-style-type: none"> ● Strongly disagree ● Disagree ● Neither agree nor disagree ● Agree ● Strongly agree
3. Do you think unpasteurised milk from suspect animals should be avoided?	<ul style="list-style-type: none"> ● Strongly disagree ● Disagree ● Neither agree nor disagree ● Agree ● Strongly agree
4. Do you think it is important to purchase animals from reliable sources?	<ul style="list-style-type: none"> ● Strongly disagree ● Disagree ● Neither agree nor disagree ● Agree ● Strongly agree
5. Do you think culling of infected animals is costly and therefore not necessary?	<ul style="list-style-type: none"> ● Strongly disagree ● Disagree ● Neither agree nor disagree ● Agree ● Strongly agree
6. Do you seek professional advice if you find that there are suspected cases of bovine tuberculosis on a farm?	<ul style="list-style-type: none"> ● Yes. I seek professional advice from Department of Veterinary Services, Malaysia ● Yes. I seek professional advice from private veterinarian ● No.
7. Do you believe that bovine tuberculosis can be eradicated from the dairy industry?	<ul style="list-style-type: none"> ● Strongly disagree ● Disagree ● Neither agree nor disagree ● Agree ● Strongly agree
8. Do you think that farmers should be held responsible for controlling the spread of bovine tuberculosis on their farms?	<ul style="list-style-type: none"> ● Strongly disagree ● Disagree ● Neither agree nor disagree ● Agree ● Strongly agree
9. How concerned are you about the potential impact of bovine tuberculosis on your herd's productivity and profitability?	<ul style="list-style-type: none"> ● Not at all concerned ● Slightly concerned ● Moderately concerned ● Very concerned

	<ul style="list-style-type: none"> ● Extremely concerned
10. Do you believe that the government should provide financial incentives for farmers to control bovine tuberculosis on their farms?	<ul style="list-style-type: none"> ● Strongly disagree ● Disagree ● Neither agree nor disagree ● Agree ● Strongly agree
Practices Section	
1. Do you routinely isolate and test new cattle for bovine tuberculosis before introducing them to your herd?	<ul style="list-style-type: none"> ● Yes, for 30 days ● Yes, for 40 days ● Yes, for 50 days ● Yes, for 60 days ● No
2. Do you keep records of your cattle's bovine tuberculosis test results?	<ul style="list-style-type: none"> ● No ● Yes, but I don't review them regularly ● Yes, I review them occasionally ● Yes, I review them regularly ● Yes, I review them frequently
3. How do you dispose of cattle that test positive for bovine tuberculosis?	<ul style="list-style-type: none"> ● Sell them for slaughter ● Euthanize them ● Quarantine them ● Other (specify)
4. How often do you clean and disinfect equipment and facilities to prevent the spread of disease?	<ul style="list-style-type: none"> ● Never ● Rarely ● Occasionally ● Regularly ● Always
5. Is the cattle shed and equipment cleaned and disinfected after each use?	<ul style="list-style-type: none"> ● Yes, state the disinfection: _____ ● No
6. Are your cattle reliant on a natural water source such as a pond, river, well?	<ul style="list-style-type: none"> ● Yes ● No
7. Is the grazing field shared with any neighboring animal herds?	<ul style="list-style-type: none"> ● Yes ● No
8. How often do you consult with a veterinarian about bovine tuberculosis prevention and control measures?	<ul style="list-style-type: none"> ● Never ● Rarely ● Occasionally

	<ul style="list-style-type: none">● Regularly● Always
9. What would you do if you were infected with tuberculosis?	<ul style="list-style-type: none">● Go to hospital or clinic● Go to pharmacy● Go to traditional healer

