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RELATIONSHIP BETWEEN OCCUPATIONAL EXPOSURES TO THE BIOAEROSOL AND RESPIRATORY SYMPTOMS AMONG VETERINARIAN PRACTITIONER IN SELANGOR

ZULAIDAH BINTI MAHMUD

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BY

ZULAIDAH BINTI MAHMUD

Thesis submitted in fulfillment of the requirement for the degree of Bachelor Science (Environmental and Occupational Health) from the Faculty of Medicine and Health Sciences, Universiti Putra Malaysia

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ABSTRACT

RELATIONSHIP BETWEEN OCCUPATIONAL EXPOSURES TO THE BIOAEROSOL AND RESPIRATORY SYMPTOMS AMONG VETERINARIAN IN SELANGOR

Zulaidah M.,Emilia ZA.,Azmiza J

Introduction: Evidence show that bioaerosol were associated with the increased of risk of respiratory disease among veterinary practitioner population. In the companion animal clinic, the main animal treated were dogs and cats which were the main source of the allergen. Important factors that contribute to the indoor air quality is ventilation. Inefficient mechanical ventilation system (MVAC) encourages microbial growth. No requirement for ensuring the ventilation level of companion animal clinic is mandatory in Malaysia. **Objectives**: This research was focused on the relationship between occupational exposure to the bio aerosol with the respiratory symptom among veterinary practitioner in companion animal clinic in Selangor area. **Methodology**: Environmental and biological monitoring were conducted at the selected companion animal clinic. The instruments that we used in this research were Duosas Super 360 microbiological air sampler and Q-Track Plus Model 8554 Monitor for monitoring the level of carbon dioxide, temperature and humidity in the companion animal clinic. A self-administered questionnaire from the International Union Against Tuberculosis and Lung Disease (IUATLD), European Community Respiratory Health Survey (ECRHS) and Industry Code Of Practice IAQ 2010 with some modification was used for the assessment of respiratory symptom in this study **Result:** Overall there no significant association found between the bio-aerosol exposure and respiratory symptom. Chi-square analysis show there is no significant association between the bioaerosol and cough, phlegm production, headache, sneezing and tearing eyes. Sneezing shows the highest prevalence (50%) followed by stuffed nose (28.6%), headache (16%), production of phlegm (17.9%) and coughing, tearing eyes (16.7%). The measurement of carbon dioxide, temperature and humidity shows, some clinic exceed the recommended limit. **Conclusion:** There is no significant association between the bioaerosol exposure and respiratory symptom among veterinarian. **Recommendation:** Improve ventilation in indoor air companion animal clinic by installing air cleaning devices to reduce the exposure to the bioaerosol.

Keywords: Bacteria, fungi, respiratory symptom, veterinary practitioner, animal clinic

ABSTRAK

MENGKAJI HUBUNGAN ANTARA PENDEDAHAN KEPADA BIOAEROSOL DAN SIMPTOM RESPIRATORI DALAM KALANGAN PENGAMAL VETERINARI DI SELANGOR

Zulaidah M., Emilia ZA., Azmiza J

Pengenalan: Bukti telah menunjukkan terdapat hubungan yang signifikan antara pendedahan kepada bioaerosol dengan risiko mendapat penyakit pernafasan di kalangan pengamal veterinari. Di klinik haiwan kesayangan, haiwan yang utama dirawat di ialah anjing dan kucing yang merupakan sumber utama alergen. Faktor penting yang membawa kepada persekitaran yang baik adalah pengudaraan. Kebanyakkan kulat hadir di persekitaran tertutup adalah disebabkan oleh pemgudaraan semula jadi ataupun pengudaraan mekanikal. Sistem pengudaraan mekanikal yang tidak cekap akan menggalakkan pertumbuhan kulat. Tiada garis panduan yang menyatakan tentang pengudaraan secara specifik di klinik haiwan kesayangan di Malaysia. **Objektif**: Tujuan kaji selidik ini dijalankan adalah untuk mengenalpasti hubungan di antara bioaerosol dan kesan kepada gejala pernafasan di kalangan veterinari di klinik haiwan kesayangan di kawasan Selangor. **Metodologi:** Dalam kaji selidik ini,instrumen yang digunakan adalah Duosas Super 360 sampler udara mikrobiologi dan Q-Trak IAQ Monitor untuk mengukur tahap karbon dioksida, suhu dan lembapan di klinik haiwan kesayangan. Untuk mengenalpasti gejala pernafasan, soal selidik daripada Kesatuan Antarabangsa Menentang Tuberculosis dan Penyakit Lung (IUATLD), Kajian Eropah Komuniti Respiratory Kesihatan (ECRHS) dan Industri Kod Amalan (ICOP) 2010 dengan beberapa pengubahsuaian telah digunakan untuk penilaian gejala pernafasan dalam kajian ini. **Keputusan dan perbincangan:** Secara keseluruhan, tiada hubungan yang signifikan di antara pendedahan kepada bioaerosol dan gejala pernafasan di kalangan pengamal veterinar. Data analisis *Chi-square* menunjukkan tiada hubungan yang signifikan antara bioaerosol dengan batuk, penghasilan kahak, sakit kepala, hidung tersumbat dan mata berair. Simptom bersin menunjukkan prevalen yang tinggi iaitu (50%), hidung tersumbat (28.6%), sakit kepala (16%), penghasilan kahak (17.9%)batuk, dan mata berair (16.7%). Bacaan karbon dioksida, suhu dan lembapan menunjukkan kebanyakkan klinik melebihi paras yang disarankan. **Kesimpulan:** Tiada hubungan yang signifikan antara pendedahan kepada bioaerosol dan gejala pernafasan di kalangan pengamal veterinari. **Recommendation:** Meningkatkan pengudaraan di dalam klinik haiwan kesayangan dengan memasang alat untuk mencuci udara bagi mengurangkan pendedahan kepada kulat dan bakteria di dalam persekitaran klinik haiwan kesayangan.

Kata kunci: bakteria, kulat, gejala pernafasan, pengamal veterinari,

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LIST OF ABBREVIATIONS

ACGIH	American Conference of Governmental Industrial Hygienist
ASHRAE	American Society of Heating, Refrigerating and Air Conditioning Engineers
CFU	Colony Forming Unit
ICOP IAQ 2010	Industry Code of Practice (Indoor Air Quality) 2010
NIOSH	National Institute of Occupational Safety and Health
SDA	Saboraoud dextrose agar
TSA	Tryptic soy agar
WHO	World Health Organization

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CHAPTER 1

INTRODUCTION

1.1 Background

Indoor air quality (IAQ) is an increasingly important issue for occupational and public health (Clarke and Nikkel 1995; Reynolds et al. 2001). There are several factors that effect indoor air quality which are biological, chemical and physical contaminants. Bio-aerosol (biological) can be defined as an aerosol or the particulate matter of the microbial, plant or animal origin that also known as organic dust that is suspended in the indoor environment. Viable bioaerosol particles, have been associated with respiratory allergies and asthma and have been linked to the airborne transmission of various infections known as building-related illnesses (e.g. Legionnaires' disease, aspergillosis; Stetzenbach 1997; Huang et al. 2008).

Bioaerosols contribute to about 5–34% of indoor air pollution (Srikanth et al. 2008). Meklin et al., has found that high concentration of the viable airborne bacteria usually indicates insufficient ventilation of the building. The major sources of the bio-aerosol in animal companion clinic is from the occupational exposures to the animals, animal wastes,feed, and bedding material. For the small animal clinic, they treated mostly dog and cats. The major allergen for the cat is Fel d 1 (Felis

domesticus) and for the dog, Can f 1 (Canus familiaris) Bush et al., (1998). Contact with cats and/or dogs has been reported as a cause of self-reported work-related respiratory symptoms in veterinarians (Susitaival et al., 2003)

Animal handling worker and veterinary practitioner are at high risk because of occupational exposure to the infected animal. According to the study conducted by Samadi et al., (2013) state that 75% veterinarians students show the respiratory symptoms after visited the pig barn for three hours.

Exposures to the bio-aerosol give wide health effect including contagious infection, acute toxic effect, allergies and also cancer (Douwes et al., 2002). A study among all 565 US members of the Association of Zoo Veterinarians has shown that 30.2% of veterinarian reported having a zoonotic infection (Hills et al.,1998). This study proves that this is the big issue among veterinarian that is work with the animal. Not only the veterinary practitioner, other occupation such as farmers, waste recycling worker, agriculture also have a high risk for developing health problem because of the exposure to the bio-aerosol.

Both Tielen et al., and also Samadi et al., study shows there is an association between the respiratory symptoms and duration of the exposures to the animals. Based on the previous study reported a high prevalence of work-related respiratory symptom including rhinitis (69%) a cough and chest tightness (53%), wheeze (31%) and wheeze accompanied with airways obstruction.

1.2 Problem statement

The increase of bio-aerosol exposure associated with the inadequate ventilation system in the building. As for the veterinary practitioner that work in the private or government clinic, they face some sort problem related to the exposure to the bio-aerosol. The clinic is the building with enclosed structure if the ventilation system does not adequate to supply the clean air it will cause the health problem to the occupants.

Veterinary practitioner need follow the requirement stated in the Veterinary Surgeon Act 1974 specifically under Section 17(2) related to the Companion Animal Premise And Practice.The premise has to be approved based on the requirement before going to practice (Malaysian Veterinary Council, 2016). The requirement mention about the lighting, the properties of the floor and internal wall. Besides that, it also mentions about the ventilation of the animal facilities. However there no specific value of the ventilation specified to ensure the ventilation of the premise is sufficient to circulate the indoor air of the building. The only mention to keep the kennel and animal well-ventilated, well-lighted and washable. So there is no specific value about the ventilation stated for of the premises

The ventilation system of the animal facilities should be seriously maintained to ensure the contaminants that present in the environment adequately circulated throughout the building of animal facilities. A microbial growth may occur in a mechanical ventilation system equip with low-efficiency filters, humidifiers that used

Water recycling or in the area which water condensation remain stagnant and large recirculation of the air is present (Wu et al. 2005; Huang et al. 2008).

Microorganisms can thus spread in the indoor air by the ventilation system and be inhaled by the people working or living in buildings (Parat et al. 1997; Mendell et al. 2008). It will possess a risk to building occupants.

Despite in this situation, at present in the Malaysia, there is a lack of study related to the bioaerosol exposure specified for veterinarian population including animal technician and students working in animal companion clinic. Biological risk continued to be the main occupational risk for the veterinarian, this is because of the exposure to the source of biological agents. According to the NIOSH, stated that there are approximately two million workers with jobs requiring constant handling of animals.

1.3 Study Justification

Currently, there is a gap of knowledge in the occupational exposure database on bio-aerosol exposures in the indoor environment among veterinary practices in Malaysia. This study will provide exposure assessment of the bio-aerosol to health effect among veterinary practitioner in the animal companion clinic. The study will provide the database on occupational bio-aerosol exposures among veterinarian population in terms of short term output. While for the long term outputs, specific requirement and recommendation on the ventilation of the premise used by the veterinary practitioner can be developed and implemented.

Other than that, the study will be able to identify the risk associated with bio-aerosol occupational exposures and provide the management and method to control the exposure as low as practicable. This is stated in occupational safety and health act 1994 Section 15 that, it shall be the duty of the every employer and self-employed person to ensure, so far as is practicable the safety and health welfare at work of all his employees.

1.4 Conceptual framework

The conceptual framework of research activities are shown in Figure 1.0. This was use to assist and guide the researcher in conducting the study. The aim of this study is to determine the relationship between occupational exposures to the bio-aerosol with the respiratory symptoms among veterinarian in Selangor.

From the framework, veterinary practitioner are exposed to the many types of hazard during occupational exposures in the animal clinic. The hazard can be at categorized as a biological hazard, chemical hazard and physical hazard. Bioaerosol are classified in a biological hazard. For the bio-aerosol, in this study researcher only focusing to the bacteria and fungi only. The exposure to the bio-aerosol through the ventilation in the indoor building which is in companion animal clinic.

The research will also assess the respiratory symptom because of the occupational exposures to the bio-aerosol among veterinarian. The questionnaire on respiratory symptom modified form the was modified from International Union against Tuberculosis and Lung Disease (IUATLD) questionnaire and European Community Respiratory Health Survey (ECRHS) questionnaire and also from Industry Code Of Practice (ICOP) 2010.

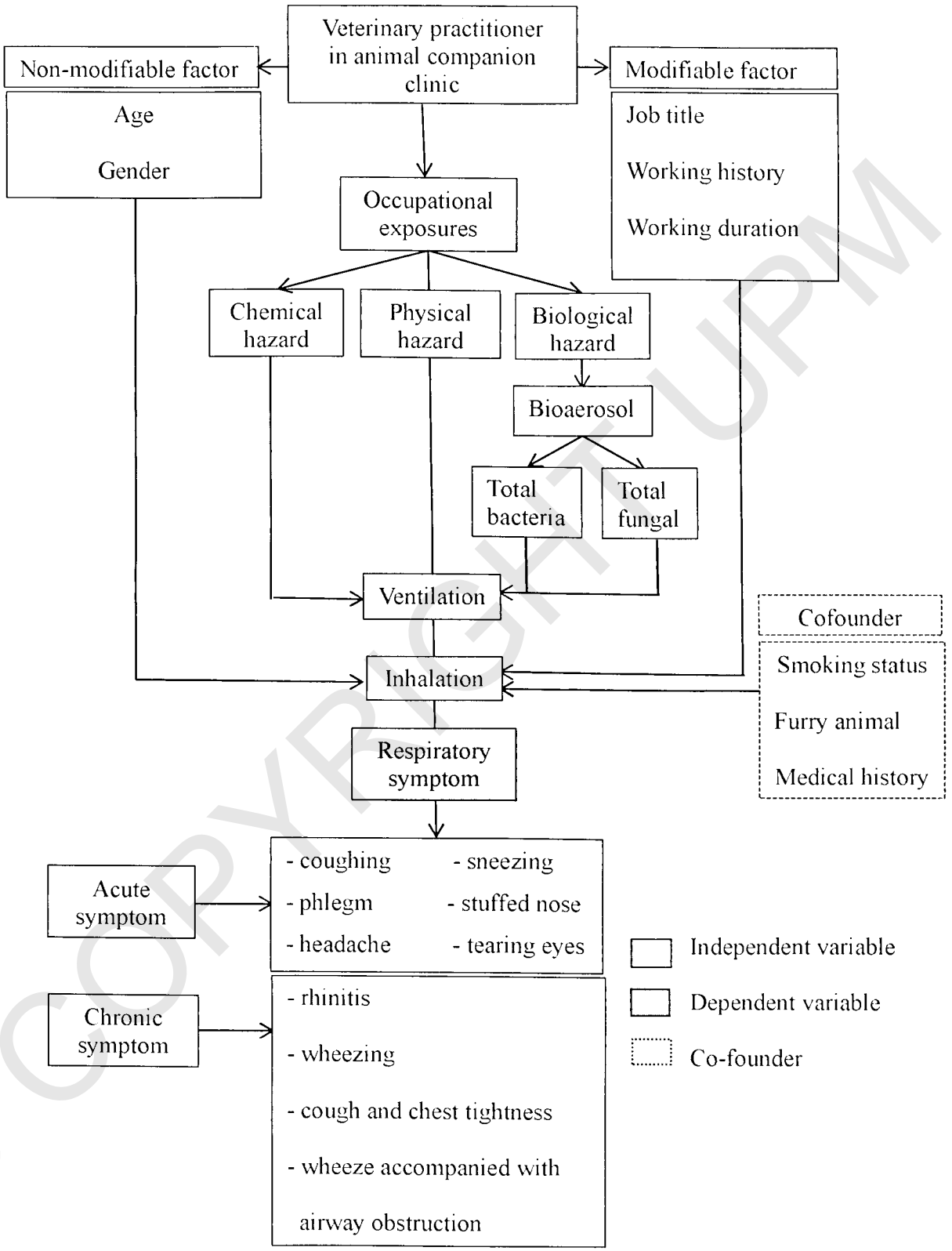


Table 1.0 : The conceptual framework of the research

1.5 Research objectives

1.5.1 General objective

To study the relationship between occupational exposures to the bio aerosol and respiratory symptoms among veterinary practitioner in companion animal clinic in Selangor.

1.5.2 Specific objectives

i. To study sociodemographic information of the veterinary practitioner.
ii. To determine the characteristic information of companion animal clinic.
iii. To determine the prevalence of respiratory symptom among veterinary practitioner in companion animal clinic
iv. To determine the indoor bio aerosol concentration in the companion animal clinic
v. To measure the carbon dioxide concentration,temperature and humidity in the companion animal clinic
vi. To determine the association between the bio aerosol exposures and respiratory symptom among veterinary practitioner in Selangor

1.6 Study hypothesis

There is a significant association between occupational exposures to the bio-aerosol and respiratory symptoms among veterinary practitioner

1.7 Definition of term

1.7.1 Conceptual definition

a) Bioaerosol

Bioaerosols are airborne particles that are either living (e.g. bacteria, fungi) or originate from living organisms that are ubiquitous, highly variable and complex and are natural or man-made in origin. (Bonetta et al., 2009).

b) Respiratory symptom

Respiratory symptom comprise a vast range of inflammation and discomfort throughout the respiratory track.Symptom that affect the nose,throat and lungs are typically considered as respiratory symptom (Meklin et al., 2005).

c) Small animal practitioner

Those were spending ≤ 75% of their times with the pets such as cats and dogs.

1.7.2 Operational Definition

a) Bioaerosol

Indoor air environment was taken by using Duosas Super 360 microbiological air sampler for each selected point. Growth medium (TSA and SDA) and were used to culture the bioaerosol. Agar plate was incubated at 37 °C and 25°C for bacteria and fungi respectively.The total concentration of bio aerosol calculated as colony forming units (CFU) per meter cubic volume of air sampled.

b) Bacteria concentration

The number of bacteria were calculated in the form of colony forming units. Then, the concentration obtain was compared to the control. According to WHO, the safe level of bacterial concentration recommended was (<500 CFU/m^3)

c) Fungal concentration

The fungal concentration were calculated in the form of colony forming units. According to the WHO, the safe level of fungi concentration recommended was (<1000CFU/m^3) in indoor air quality. (ACGIH,1989; Rao et al., 1996) recommended 200 CFU/m^3 as a guideline for indoor fungal concentration.

CHAPTER 2

LITERATURE REVIEW

2.1 Companion animal clinic

Companion animal clinic means clinic that provides services of vaccination,general health care,surgery and advisory as stated in the Second Schedule,Veterinary Surgeon (Companion Animal Premise and Practice) Directive 2,2015. Martin and Robert (2001) said that the most important animal allergen were derived from mammals principally cats,dogs,rats,mice,horses,cows which secrete and excretes allergen into the environment.Cats and dog allergen commonly cause allergies in the home and affect the general population.

2.2 Occupational exposures among veterinary practitioner

Veterinarians are probably at high risk of developing infectious diseases because of their high likelihood of contact with infected animals. Veterinary population usually involved many occupational risks. According to WHO, main occupational risk factors defined as physical, chemical, biological or other agents that may cause harm to an exposed person in the workplace and is potentially modifiable. Apart from the veterinarian practitioner, the care takers or anyone who has direct contact with the animal are high risk workers.

2.3 Indoor air quality

Indoor air quality refers to the air quality within and around the building structure especially its relates to the health and comfort of building occupants.(USEPA,2017)

2.3.1 Biological hazard

Many type occupational field were exposed to the biological hazard including health care, agriculture, forestry,veterinary and biotechnology treatment and waste disposal.(Corrao et al., 2012). Biological agent such as bioaerosol consists of pathogenic or non-pathogenic live or dead bacteria and fungi, viruses, high molecular weight (HMW) allergens, bacterial endotoxins, mycotoxins, peptidoglycans, β(1→3)-glucans and pollen, plant fibers (Douwes 2002).

Bio-aerosol exposure levels are associated with the microbial contamination of the source materials and to what extent these materials can become airborne. The most well-known occupational health effects related to bio-aerosol exposure are respiratory symptoms as shown in a study conducted by Samadi et al., (2013). Result from their study demostrated that strong association between bio-aerosol exposures with the increased risk of developing respiratory disease among the veterinary population (Samadi et al 2013).

2.3.2 Physical hazard-ventilation

One of the most important factors affecting IAQ (Indoor Air Quality) is how the building is heated, ventilated and air conditioned (Seppänen and Fisk2002). Inadequate ventilation can increase indoor pollutants level by not bringing enough outdoor air to dilute emissions from indoor sources and by not carrying indoor air pollutant out of the area. High temperature and humidity level can also increase concentration of the same pollutants. Outdoor air enters and leaves a building through opening .joints,cracks in walls,floor,ceiling,windows and doors (USEPA 2017). The ventilation devices including air conditioner,exhaust fan,ceiling fan, and dehumidifier and others.

2.4 Route of exposures –inhalation

The pathways that allergens or bio-aerosol can be transmitted and enter to our body known as a route of exposures. Route of the occupational exposure mainly dermal, inhalation and also eyes. Inhalation of animal allergens is considered the most common route of occupational exposure. Following exposure, individuals might become sensitized (IgE-mediated) , subsequently allergic symptoms develop, with allergic rhinitis as the most common symptom, followed by allergic conjunctivitis, and ultimately resulting in work-related asthma. Worker may exposed by inhalation of the dust containing biological agents and deposited in various region of respiratory symptom.(Corrao et al., 2012)

2.5 Respiratory symptoms

Exposure to the bio-aerosol associated with a wide range of the health effect including rhinitis, chest tightness, wheeze and wheeze accompanied with airway obstruction. The was a study reported the veterinary practitioners exposed to farm animals had a distinctly higher prevalence of a chronic cough, chronic phlegm production, and wheeze compared to veterinarians with other specialties (Samadi S, Wouter.I.M, Heederik D.J.J 2013). These studies suggest that veterinary populations are at risk of developing allergic sensitization, allergic rhinitis, conjunctivitis, asthma, and dermatitis, with prevalence ranging between 40% and 69% for respiratory symptom and 11% and 46% for dermal symptoms (Samadi S, Wouter.I.M, Heederik D.J.J 2013).The study found that the veterinary practitioners exposed to farm animals had a distinctly higher prevalence of chronic cough, chronic phlegm production, and wheeze compared to others. According to a study by Tielen (1996) among veterinarian the symptoms during and within 4-8 hr after working with animals are coughing, phlegm, shivering, nausea, shortness of breath, headache, dizziness, sneezing, stuffed nose, tearing eyes.

2.6 Other factors contributed to the developing the respiratory symptom

Developing respiratory symptoms also associated with the duration spent with the animals. Besides exposure to pig barns, which is relatively well established as an occupational health risk, exposure to dairy barns, poultry houses, and horse stables are also considered to be risk factors for the development of respiratory problems such as respiratory symptoms, airway responsiveness, and chronic bronchitis. According to the

study conducted by Samadi et al., (2013), state that 75% veterinary students showed respiratory symptoms after visited the pig barn for three hours.

2.7 Veterinary practitioner job scope

2.7.1 Veterinarian

Veterinarian usually treat pets and generally work in private clinics and hospitals. According to the American Veterinary Medical Association, more than 75 percent of veterinarians who work in private clinical practice treat pets. They most often care for cats and dogs, but also treat other pets, such as birds, ferrets, and rabbits. These veterinarians diagnose and provide treatment for animal health problems, consult with owners of animals about preventative health care, and carry out medical and surgical procedures, such as vaccinations, dental work, and setting fractures.

2.7.2 Veterinarian technician

Generally, veterinary technician assisting veterinarian in caring for animal patient. It is also to ensure that animal patient at clinic, hospitals, rescue and zoos and receive the best possible care and attention.

2.7.3 Veterinarian assistance

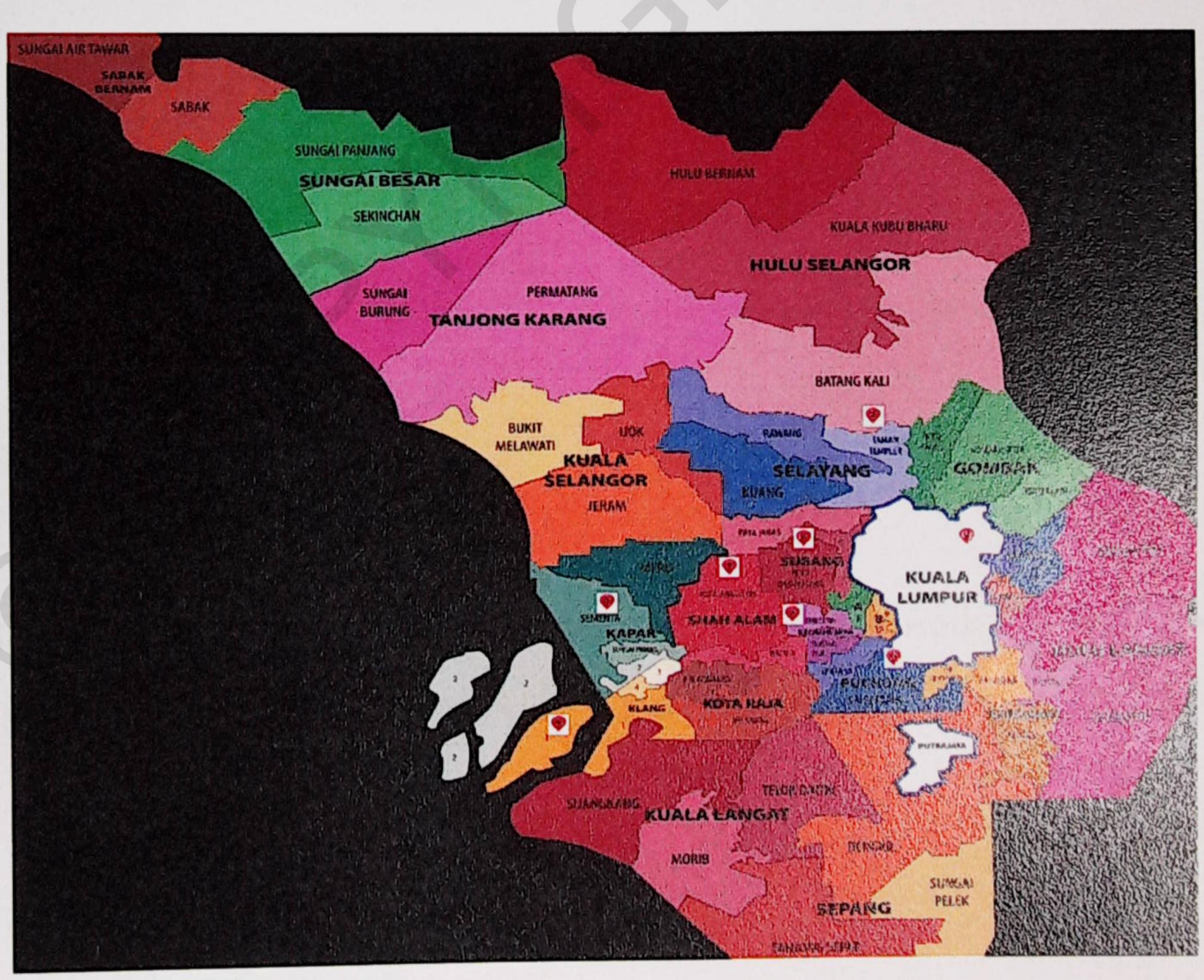
Veterinarian assistance job is to support animal doctors and technician in their daily tasks by cleaning and maintaining equipment, feeding, exercising and grooming patients, preparing patient and sanitizing surgery suites, restraining and handling patients and clerical administrative.

CHAPTER 3

METHODOLOGY

3.1 Study Location

There are nine administrative districts in Selangor, namely Klang, Hulu Langat, Sabak Bernam, Gombak, Petaling Jaya, Sepang, Kuala Langat. The district randomly selected if there is an companion animal clinic at the area as a study location. The study was conducted at the approved companion animal clinic in Selangor area.



Source : www.google.com

Figure 1.0 The study has been conducted at companion animal clinic in Selangor area

3.2 Study design

In this study, cross-sectional study design has been used to assess the occupational exposure to bio aerosol in companion animal clinic and its relationship with the respiratory symptom among veterinary practitioner in Selangor area. As the study design concerned, the measurement of the variables had been conducted at a single point in time and in a short period to assess the exposure of the bio aerosol and respiratory symptom among veterinary practitioner. This study design also provide the information about the prevalence of the respiratory symptoms and the relationship between different variables at the point in time. For instances the relationship between the temperature, humidity, ventilation and carbon dioxide throughout the study period.

3.3 Sampling

3.3.1 Sample population

The respondents were full-time veterinary practitioner work in companion animal clinic in Selangor area. The list of animal companion clinic chosen were as follow ;

1. Citivet animal clinic
2. Sri petaling veterinary clinic
3. Tasik prima veteinary clinic
4. Yap veterinary clinic

5. Petcity animal clinic
6. Kucing desa
7. Thomas veterinary clinic
8. Taqwa veterinary clinic
9. Tawakkal animal clinic
10. Lee veterinary clinic
11. Klinik haiwan mesra bangi
12. Healing room veterinary clinic
13. Cat care veterinary clinic
14. Maya veterinary clinic

3.3.2 Sample frame

The sampling frames of this study was a list of the companion animal clinic which was obtained from the website of Malaysian Small Animal Veterinary Association and as well as result from the Google search engine.

3.3.3 Sampling size

The sample study consists of 87 veterinary practitioner which is full time in veterinarian practices specifically in companion animal clinic. The sample size determination is based on the formula of Lemeshow(1990).

This formula used to calculate the sample size calculation for cross sectional study among veterinary practitioner.

$$n = \frac{z^2_{1-\alpha/2} P(1-P)}{d^2}$$

Where,

N = Sample size

$z^2_{1-\alpha/2}$ = 1.96 standard errors associated with confidence interval (95%)

P = Prevalence of respiratory symptoms from a reference study

d = Desired precision (0.05)

The prevalence of the acute respiratory symptoms 4-8 hours after working with animal were obtained from the study conducted by Tielen et al. (1996).The three prevalence were for symptoms of tearing eyes, acute headache and sneezing.

The calculation are as below.

3.3.3.1 Tearing eyes

Based on Tielen et al. (1996). The prevalence of tearing eyes is 2.4%

$$n = \frac{z^2_{1-\alpha/2} P(1-P)}{d^2}$$

N = 35.99 + 20%

N = 43.188

The total sample size required according to the sample size calculation is 43 respondents. Due to the likely effect of attrition, the number of sample size calculation is increase 20%

3.3.3.2 Acute headache

Based on Tielen et al. (1996), the prevalence of acute headache is 1.2 %

$$n = \frac{z^2_{1-\alpha/2} P(1-P)}{d^2}$$

N = 18.2 + 20%

N = 21.84

The total sample size required according to the sample size calculation is 22 respondents. Due to the likely effect of attrition, the number of sample size calculation is increase 20%

3.3.3.3 Sneezing

Based on Tielen et al. (1996). The prevalence of sneezing is 1.2 %

$$n = \frac{z^2_{1-\alpha/2} P(1-P)}{d^2}$$

N = 18.2 + 20%

N = 21.84

The total sample size required according to the sample size calculation is 22 respondents. Due to the likely effect of attrition, the number of sample size calculation is increase 20%

Based on three sample size calculation, the minimum sample size for this study is 87 respondents.

3.3.4 Inclusion criteria

i. Male and female veterinary practitioner
ii. Age range 18 years old – 65 years old
iii. More than 1 year experience in veterinary field

3.3.5 Exclusion criteria

i. Pregnant women

ii. People with chronic respiratory disease

3.4 Instrumentation

3.4.1 Approval letter

Consent letters were distributed among the listed respondent to get their consent to participate in this study.

3.4.2 Questionnaire

A self-administered questionnaire from the International Union Against Tuberculosis and Lung Disease (IUATLD), European Community Respiratory Health Survey (ECRHS) and Industry Code Of Practice (ICOP) 2010 with some modification was used for the assessment of respiratory symptom in the study.The questionnaire was back-to-back translated. The questionnaire was provided in English. The questionnaire was distributed to the building occupants to get the information related to the demographic background and socioeconomic of the respondents such as personal information, health status, family history, work

exposure and indoor environment. It also contained a set of questions on respiratory symptom during the last 12 months.

The question on respiratory symptom shortly after the exposure to the bioaerosol was based on the study conducted by (Tielen et al., 1996)which include coughing, phlegm, shivering, nausea, shortness of breath, headache, dizziness, sneezing, stuffed nose, tearing eyes.

3.4.3 Q-Track Plus Model 8554 Monitor

Carbon dioxide, temperature and relative humidity were measured by using Q-Track Instrument (TSI Inc). The measurement was performed at the specific time interval at the premise. Laser measurement meter was used to calculate the volume of each room. The measurement was done at during the data collection at each room of the companion animal clinic rooms.

3.4.4 Environmental Sampling

A walk-through building inspection was conducted to identify sampling location, sampling points, the presence of any sign of dampness and mold growth, general animal companion clinic hygienic condition and the present of potential contaminant sources including carpet.

3.4.5 Duosas Super 360 Microbiological Air Sampler

In each selected companion animal clinic, bacterial and fungal sampling were in average conducted in five points. The points were consultation room, surgery room, cat ward, dog ward and also the waiting area.The sampling of the bacterial and fungal was conducted using a single-stage Andersen viable particulate cascade impactor at the flow amount of 28.3L/min. The air was sucked into the sampler through the aluminum plate perforated with the 400 holes and laminar air flow was directed onto a "contact plate" with the agar in a standard petri dish. For quality control purposes, before the sampling, the inside of the sampler was disinfected by using 70% alcohol and prior to insertion of the media plate.

Samples for the bacteria culture were collected in media plate containing Tryptase Soy Agar (TSA) while for the fungal saboroud dextrose agar (SDA) was used. Both of the agar plates were placed according to the collection stage inside the sampler after disinfected with the 70% alcohol. After the sampling was taken, the culture media then immediately taken to the microbiology laboratory for incubation process. The temperature was set up 37°C for 2 day for bacteria while for the fungal culture media 4 days at 20-25°C for fungi cultivation. All samples were taken during daytime and working hours. Blanks required for each of the animal companion clinic. microbiological sampling were carried out for 2 minutes and measurement were taken at about 1.0m height and from the wall. The blanks were taken for each clinic for quality control purposes. The bacteria and fungal sample were taken for duplicate sample to get the average concentration.

3.4.5.1 Calculation of the bioaerosol concentration

The airborne bacteria and fungi concentration was calculated by dividing the number of colonies formed on the culture medium known as colony forming unit (CFU) Eq. (1) after the incubation process with the air volume. Eq. (2) The total number of sample were 61 for airborne bacteria and fungi respectively. (Eq. (3))

Colony forming unit (CFU) = colony counted on agar plate (1)

Air volume (m^3) = 28.3L/min x sampling time (min) / 10^3 (2)

Total number of samples : measuring spots = 61 (3)

The result were presented as a cubic meter of air had been collected to allow for comparison of samples when different volumes were used.

3.5 Quality Control

i. Pre-test questionnaire 10% were distributed to the respondents that do not include in this study. To ensure the respondents understand the questionnaire and if there is amendment needed. The reliability of the questionnaire is by using alpha Cronbach value.

ii. Before start of the data collection all the instruments used to measure the parameter should be calibrated and fully charged to ensure well functioned during the measurement.

iii. The equipment was disinfected between each sampling point and each agar plate was seal with the parafilm after the samples were collected before being placed in a sterile plastic bag.

iv. Samples were kept in a cooler not more than 6 hours prior to being delivery to the laboratory

v. Protection gloves and surgical face mask were used during sample collection.

3.6 Data Analysis

All the data obtained were analyzed by using the statistical analysis by performing SPSS Version 22 (Statistical Package for Social Sciences) and Microsoft excel for Windows 7. Descriptive statistic including mean, median, and the standard deviation were determined to analyze the distribution of all variables include in this study.

The descriptive statistic were used to analyze the descriptive data including sociodemographic of the respondents and the respiratory symptom. This statistical analysis was done to determine the percentage, means, medians, standard deviation, ranges, minimum and maximum value.

The normality test was used by using Kolmogorov-Smirnov and Shapiro-Wilk.Normality is assumed for the significant level of $p>0.05$. Chi-square was used for categorical data. Chi-square was used to assess the association of the respiratory symptom and bio-aerosol concentration.

Multiple logistic regression used to identify significant risk factors associated with the respiratory symptom among veterinarian. The bioaerosol concentration was categorized based on the median value. A value that was higher than median categorized as higher, while the value that lower than median was categorized as low.

3.7 Ethical consideration

An ethical clearance for the study obtained from Faculty of Medicines and Health Science, Ethical Committee, Universiti Putra Malaysia,

i. Study location was chosen based on the approval by the owner of the companion animal clinic.
ii. Briefing on the study was carried out on the respondents prior to the commencement of the study.
iii. Consent letter was distributed to the respondents together with the questionnaire.

3.8 Study limitation

The study limitation includes the study design which was a cross sectional study using the questionnaire in which the response to the questions based on the recalled memories of the respondents, conferring potential information bias in which the result is only applicable to estimate the prevalence. Besides for the exposure to the bio-aerosol may not represent the true bio aerosol exposure because of the sampling point not only the source of exposure. The reason was the respondents might get the exposure from the other places. The recall bias may occur due to some questionnaire related to the respiratory symptom experienced by the respondent for last 12 months.The velocity of the air movement was not measured because of the equipment constrain and limited man power. Study population less than minimum sample size required thus reduce the power of study.

CHAPTER 4

RESULT

Overall, the response rate, 14 out of 68 (response rate of 20.5%) of the companion animal clinic was involved, 84 out of 95 (response rate of 88.4%) of the respondents participated in this study. The respondents were those who work in the veterinary field. The age of the respondent was from 18-65 years old. 55% of the respondents involved in this study aged 18-30 years old. The ethnicity of the respondents was dominated by Malay (46%), Chinese (35%) and Indian (19%). Most of the respondents hold a diploma. Most of the respondents (89.3%) have less than RM5000 monthly income. Majority of the respondent were female and not smoking. Respondents were categorized into veterinarian, veterinarian assistant and receptionist. Most of the respondents (54%) in this study were involved veterinarian assistant and consist of both genders.

Table 4.1 : Demographic information of the respondents (n=84)

Variable	Frequency (N= 84)	Percentage (%)
Age		
18-30	46	54.8
31-45	32	38.1
46-65	6	7.1
Gender		
Male	32	38.1
Female	52	61.9
Level education		
STPM	18	21.4
Diploma	29	34.5
Degree	32	32
Master	5	6.0
Monthly income		
Less than rm5000	75	89.3
Less than rm7500	8	9.5
Less than rm10000	1	1.2
Type of household		
Apartment	26	31.0
Semi-D/terrace/	46	54.8
bungalow	12	14.3
Others		
Ethnicity		
Malay	39	46.4
Chinese	29	34.5
Indian	16	19.0
Smoking status		
Yes	11	13.1
No	73	86.9
Job categories		
Veterinarian	23	27.4
Veterinarian assistant	45	53.6
Receptionist	16	19.0

Descriptive analysis

Table 4.2 Shows that the characteristic of the companion animal clinic . The information obtained were the total number of the worker in the companion animal clinic, the types of ventilation system used and also any sign of mold growth for each selected room.

Table 4.2 : Characteristic of the animal clinics (n=14)

Clinic numbers	Sampling location	Total number of Worker	Ventilation devices					Room volume (m^3)	Sign of mould growth
			Air conditioner	Exhaust fan	Fan	Windows	Humidifier		
1	Consult	3	√	X	X	X	X	27	X
	Surgery		√	√	X	X	X	20	√
	Treatment room		√	√	X	X	X	24	X
	Cat boarding room		√	√	X	X	X	19	√
	Waiting area		√	X	X	X	X	33	X
2	Consult	3	√	X	X	X	X	23	X
	Surgery		√	X	X	X	X	38	X
	Dog boarding room		X	X	√	X	X	47	X
	Cat boarding room		√	√		X	X	24	X
	Waiting area		√	X	X	X	X	33	X
3	Consult	4	√	X	X	X	X	28	X

	Surgery		√	X	X	X	X	29	X
	Dog boarding room			√	√	X	X	40	X
	Cat boarding room		√	X	X	X	X	16	√
	Waiting area		√	X	X	X	X	27	X
4	Consult	9	√	X	√	X	X	21	X
	Surgery		√	X	√	X	√	21	X
	Dog boarding room		X	√	√	√	X	47	X
	Cat boarding room		√	X	√	X	X	24	X
	Waiting area		√	X	X	X	X	39	X
	Surgery II		√	X	√	X	X	21	X
5	Consult	4	√	X	X	X	X	11	√
	Dog boarding room		X	X	√	√	X	39	√
	Cat boarding room		X	X	√	X	X	34	√
	Waiting area		√	X	√	X	X	49	√
6	Consult	3	√	X	X	X	X	14	X
	Cat boarding room		√	X	√	√	X	78	√
	Waiting area		√	X	X	X	X	26	√
7	Consult	7	√	X	X	X	X	37	X

	Surgery		√	X	X	X	X	22	X
	Dog boarding room			X	√	X	X	22	X
	Cat boarding room		X	X	X	X	X	24	√
	Waiting area		√	X	X	X	X	39	X
8	Consult	4	√	X	X	X	X	23	X
	Surgery		√	X	√	X	X	16	X
	Cat boarding room		X	X	√	X	X	84	X
	Waiting area		√	X	X	X	X	47	X
9	Consult	5	√	X	X	X	X	25	√
	Surgery		√	X	X	X	X	12	X
	Cat boarding room		X	√	√	X	X	92	√
	Waiting area		√	X	√	X	X	60	X
10	Consult	12	√	X	X	X	X	19	X
	Surgery		√	X	X	X	X	38	
	Dog boarding room		X	X	√	X	X	44	√
	Cat boarding room		√	X	√	X	X	39	√
	Boarding area		X	X	√	X	X	48	√
11	Consult	9	√	X	X	X	X	20	√

	Treatment		√	X	X	X	X	22	√
	Cat boarding room		X	X	√	X	X	29	√
	Waiting area		X	X	√	X	X	45	√
12	Consult	6	√	X	X	X	X	24	X
	Surgery		√	X	X	X	X	26	√
	Dog boarding room			X	√	X	X	29	√
	Waiting area		√	X	X	X	X	38	X
13	Consult	3	√	X	X	X	X	22	√
	Surgery		√	√	X	X	X	38	X
	Grooming room		√	X	X	X	X	55	√
	Cat boarding room		X	√	X	X	X	77	X
	Waiting area		√	X	X	X	X	94	X
14	Consult	8	√	X	X	X	X	26	X
	Surgery		√	X	X	X	X	30	X
	Cat boarding room			X	√	X	X	41	√
	Waiting area		√	X	X	X	X	61	X

Descriptive analysis

The prevalence of the respiratory symptom after shortly exposure to the bio-aerosol are shown in Table 4.3. Result from the total of 84 respondents shows that they experience sneezing (50%), stuffed nose(28.6%), headache (19.0%), coughing (16.7%), production of phlegm(17.9%) and tearing eyes (16.7%)

Table 4.3 Prevalence of the respiratory symptom after short exposure to the bio-aerosol among respondents.

Respiratory Symptom	N=84	Prevalence (%)
Coughing	14	16.7
Production of phlegm	15	17.9
Headache	16	19.0
Stuffed nose	24	28.6
Sneezing	42	50
Tearing eyes	14	16.7

Descriprive analysis

Table 4.4 The prevalence of the respiratory symptom for the last 12 months among the respondents. The most common respiratory symptoms reported include wheezing and chest tightness, shortness of breath, coughing and phlegm, animal dust and asthma. The highest prevalence were wheezing and chest tightness(14.3%), followed by shortness of breath(3.6%), cough and phlegm(7.1%), animal dust (8.3%)and asthma (3.6%).

Table 4.4 Prevalence of respiratory symptom for the last 12 month among respondents

Respiratory Symptom	N=84	Percentage (%)
Wheeze and chest tightness	12	14.3
Short of breath	3	3.6
Cough and phlegm	6	7.1
Allergy to animal dust	7	8.3
Asthma	3	3.6

Descriptive analysis

Table 4.5. The result of the bio-aerosol concentration level measured in each of the room at the companion animal clinic. Overall the level of bacteria concentration was highest at the cat and dog boarding rooms, followed by the waiting area and surgery room. However, the highest concentration of fungi was at the consultation room, followed by dog room and surgery room.

Table 4.5: Bio-aerosol concentration level in each of the room at the companion animal clinic

Clinic numbers	Sampling location	N	Bacteria concentration (CFU/m^3)	Fungal concentration (CFU/m^3)
Clinic 1	Consult	5	165	365*
	Surgery		337	249
	Treatment room		202	214
	Cat room		422*	345
	Waiting area		237	174
Clinic 2	Consult	5	431	120*
	Surgery		502*	105
	Dog room		411	102
	Cat room		442	74
	Waiting area		482	100
Clinic 3	Consult	5	291	186
	Surgery		362	422
	Dog room		482*	565*
	Cat room		440	488
	Waiting area		185	185
Clinic 4	Consult	4	248	211
	Surgery		200	74
	Dog room		260*	168*
	Cat room		248	97
	Waiting area		108	120
	Surgery*		131	88
Clinic 5	Consult	4	189	3
	Dog room		289	189*
	Cat room		237	46
	Waiting area		460*	17
Clinic 6	Consult	3	382	134*
	Cat room		385	89
	Waiting area		48	80
Clinic 7	Consult	5	208	80
	Surgery		117	397*
	Dog room		365*	166
	Cat room		185	88
	Waiting area		340	44

Clinic 8	Consult	4	245	168
	Surgery		228	105
	Cat room		117	151
	Waiting area		365*	242*
Clinic 9	Consult	4	214	105
	Surgery		257	162
	Cat room		245	120
	Waiting area		267*	82
Clinic 10	Consult	5	351	522
	Surgery		325	308
	Dog room		367	591
	Cat room		389*	520
	Boarding area		191	522*
Clinic 11	Consult	4	262	288*
	Treatment		288*	251
	Cat room		245	241
	Waiting area		185	231
Clinic 12	Consult	4	151	168
	Surgery		362*	177
	Dog room		348	202*
	Waiting area		294	102
Clinic 13	Consult	5	306	74*
	Surgery		357	40
	Grooming room		554*	43
	Cat room		54	40
	Waiting area		311	20
Clinic 14	Consult	4	434*	26
	Surgery		157	74*
	Cat room		249	67
	Waiting area		400	49

**indicate the bioaerosol concentration highest from the rest of the room*
**surgery-Point after dehumidifier was turn on.*

Table 4.6 shows the average concentration of the bacteria and fungi in each companion animal clinic. All the bacteria concentration for each companion animal clinic were less than 500 CFU/m^3. The level of fungi collected in each companion animal clinic was below the recommended concentration for good IAQ which was 1000 CFU/m^3. However 50% of the companion animal clinic was exceed the level recommended by ACGIH, 1986 ; Robertson 1996 which is 200 CFU/m^3 as guideline for indoor fungal concentration.

Table 4.6 : Mean of bacteria concentration and fungal concentration in the companion animal clinic

Clinic numbers	N	Bacteria Concentration				Fungal Concentration			
		Mean (SD)	Median	Min	Max	Mean (SD)	Median	Min	Max
Clinic 1	5	275(105)	337	165	422	269(83)	249	174	365
Clinic 2	5	454(37)	442	411	502	100(17)	102	74	120
Clinic 3	5	352(119)	362	185	482	391(124)	422	186	488
Clinic 4	6	199(65)	224	108	260	126(53)	109	74	211
Clinic 5	4	293(118)	263	189	460	64(85)	32	3	189
Clinic 6	3	272(194)	382	48	385	101(29)	89	80	134
Clinic 7	5	243(106)	208	117	365	155(142)	88	44	397
Clinic 8	4	238(102)	236	117	365	167(57)	160	105	242
Clinic 9	4	245(23)	251	214	267	117(34)	112	82	162
Clinic 10	5	324(78)	351	191	389	492(108)	522	308	591
Clinic 11	4	245(44)	253	185	288	252(25)	246	231	288
Clinic 12	4	288(96)	321	151	362	162(43)	172	102	202
Clinic 13	5	316(178)	311	54	554	44(20)	40	20	74
Clinic 14	4	310(130)	325	157	434	52(23)	58	26	74

Descriptive analysis

Table 4.7 showed carbon dioxide reading in the companion animal clinic. Based on the result obtained from the companion animal clinic, half of clinic showed higher level of CO_2 in the companion animal clinic. The level nearest to 1000 ppm and higher than 1000ppm. . Besides for relative humidity and temperature,43% and 65% respectively of the companion animal clinic exceed the limit. This exceed the limit recommended by Industry Code Of Practice Indoor Air Quality 2010

Table 4.7 : Carbon dioxide,temperature and humidity reading in the companion animal clinic

Clinic	N=84	Carbon dioxide reading	Temperature reading (°C)	Humidity reading (Rh)
Clinic 1	5	766	**33***	77*
Clinic 2	5	377	24	**85***
Clinic 3	5	331	24	**71***
Clinic 4	6	558	26	65
Clinic 5	4	545	**28***	**79***
Clinic 6	3	942	**28***	60
Clinic 7	5	728	**27***	57
Clinic 8	4	996	**27***	51
Clinic 9	4	777	**29***	**71***
Clinic 10	5	**1199***	25	**79***
Clinic 11	4	**1014***	26	**74***
Clinic 12	4	883	24	**74***
Clinic 13	5	644	26	56
Clinic 14	4	**1943***	26	**85***

Descriptive analysis

**exceed level recommended by ICOP IAQ 2010*

Carbon dioxide :1000ppm

Temperature : 23-26°C

Relative humidity : 40-70%

Association between bioaerosol concentration and respiratory symptom immediately as shown in Table 4.8. In this study, the result show there is no association between the respiratory symptom and bioaerosol concentration.

Table 4.8 : The association between the respiratory symptom and bioaerosol concentration

Respiratory Symptoms	Concentration bacteria				Concentration fungi			
	Less than 288	More than 288	X^2	p	Less than 200	More than 201	X^2	p
	Total=100				Total=100			
Coughing								
Yes	6(15.8)	8(19.5)	0.187	0.665	11(18.3)	3(15.)	0.064	0.8
No	32(84.2)	33(80.5)			49(81.7)	16(84.2)		
Production of phlegm								
Yes	8(21.1)	7(17.1)	0.203	0.776	13(21.7)	2(10.5)	1.164	0.281
No	30(78.9)	34(82.9)			47(78.3)	17(89.5)		
Headache								
Yes	8(21.1)	8(19.5)	0.029	0.865	17(28.3)	5(26.3)	0.029	0.864
No	30(78.9)	33(80.5			43(71.7)	14(73.7)		
Stuffed nose								
Yes	12(31.6)	10(24.4)	0.507	0.476	15(25)	1(5.3)	3.460	0.062
No	26(68.4)	31(75.6)			45(75)	18(94.7)		
Sneezing								
Yes	17(44.7)	23(56.1)	1.018	0.313	29(48.3)	11(57.9)	0.528	0.468
No	21(55.3)	18(43.9)			31(51.7)	8(42.1)		
Tearing eyes								
Yes	9(23.7)	5(12.2)	1.785	0.181	12(20)	2(10.5)	0.888	0.35
No	29(96.3)	36(87.8)			48(80)	17(89.5)		

Chi-square test

**significant at $p<0.05$*

CHAPTER 5

DISCUSSION

5.1 Characteristic of the companion animal clinic

A total of 14 companion animal clinic in Selangor area were involved in this study. The companion animal clinic includes old and the new building. This study was conducted by selecting a few sampling point in the companion animal clinic to determine the occupational bio-aerosol exposure among the veterinary practitioner. The walk-through was done to obtain the information about the companion animal clinic. Companion animal clinic usually treats the small animal especially dog and cat. The sampling point were selected based on the frequency of the room being used and the duration of the usage. Besides that, the sign of mold growth was observed at each of the selected room during walk-through. The most obvious growth of mold was observed in the cat and dog boarding room.

In general, every companion animal clinic has a few room such as consultation room, surgery room, cat boarding room and dog boarding room. Usually, the injured animal was separated from the healthy animal. There are also grooming room for the animal. Nonetheless, not all of the companion animal clinic provide grooming services to the customer. The consultation room was the most frequent room that was used by the veterinary practitioner, followed by surgery room. However for the dog

and cat boarding room the worker were exposed during cleaning activities, and during the treatment of the animal.

The information regarding the ventilation was collected from the clinic. Most of the clinic use the ventilation system to circulate the indoor air from the contaminants that present in the companion animal clinic. The ventilation devices that companion animal clinic uses include split air conditioner, exhaust fan, mechanical fan, and humidifier. Most of clinic use a split air conditioner to ventilate their building. There also a few animal companion clinic uses the window as natural ventilation especially to ventilate the kennel room.

In Malaysia there is no requirement that specifically mention about the ventilation in the companion animal clinic. According to the Guideline for Standard of Care in Animal Shelters (2010) state that all ventilation systems must be adequately maintained and air quality should be monitored at the level of the animal. Between 10 and 20 room air exchanges per hour with fresh air is the standard recommendation for adequate ventilation of animal facilities (European Council 1986; Johnson 2004; ILAR 1996)

5.2 Prevalence of the respiratory symptom among respondents

The prevalence of respiratory symptom was determined by using the questionnaire on respiratory symptom was modified from International Union against Tuberculosis and Lung Disease (IUATLD) questionnaire and European Community Respiratory Health Survey (ECRHS) questionnaire and also from Industry Code Of

Practice (ICOP) 2010. Symptom were analyzed in two parts, the first one is the respiratory symptom experienced by veterinary practitioner for last 12 months while the second part focused on the prevalence of the respiratory symptom experienced shortly after the exposure to the bio-aerosol. The effect from short exposure show higher prevalence compares to the respiratory symptom experience in last 12months.

In this study, the result shows the increase the prevalence on the respiratory symptom which including sneezing, stuffed nose and headache. The highest prevalence respiratory symptom experienced by the respondents were sneezing (50%), followed by stuffed nose (28.6%), and headache (19.0%).This study result is consistent with the previous study conducted in Netherland (Tielen et al, 1996). The study shows the common symptom were a cough, nasal-throat, sinus irritation, as well as a headache. According to the study conducted by the Backstrom and Julie (1994) revealed that 38.6% of the students reacted at the farm, while 49% fell ill within 7 days after the herd visit. Based on the previous study Martin and Robert (2001) shows that the most potent animal allergens are associated with mammalians, such as cows, horses, cats, dogs, rats, and mice.

5.3 Bio-aerosol concentration level in each of the room at the companion animal clinic

Furthermore, this study investigated the concentration of the viable bacteria and fungal bioaerosol in companion animal clinic in Selangor. Overall, it was demonstrated that indoor air concentration of bacteria in all of the companion animal

clinic were within the recommended limit established by the National Institute for Occupational Safety and Health (NIOSH), World Health Organization (WHO) at 1000 CFU/m^3 total number of bioaerosol particles in which the culture count for total bacteria should not exceed 500CFU/m^3. ACGIH,1989: Rao, et al., (1996) recommended 200CFU/m^3 as a guideline for indoor fungal bioaerosol and the result showed that a few animal companion clinic was exceeded the recommended level.

The clinic were Clinic 1(269 ± 83), Clinic 3(391 ± 119), Clinic 10 (492 ± 108), Clinic 11(252 ± 25). Clinic 1(450 ± 299) and 2 (454 ± 37) had highest indoor bacteria concentration,while for the fungi concentration four clinic had highest level compared to the other clinic. The respective animal clinic are Clinic 1 (269 ± 83), Clinic 3(392 ± 124), Clinic 10 (492 ± 108), Clinic 11(252 ± 25).

Both of the bacteria and fungi concentration in this clinic exceeded the recommended limit thus should be unacceptable for normal occupation due to the poor hygienic indoor air quality (Zorman & Jersek,2008 and Robertson,1997). According to the walkthrough building inspection before the data collection, the for Clinic 1 and Clinic 3 show the unhygienic conditions was obvious compared to the other clinic. The presence of dampness on the indoor surfaces where mould can be easily proliferate,thus increase in indoor microbial concentration (Zuraimi & Tham 2008).

Besides that, the odor that comes from the companion animal clinic also can be smell once entered the companion animal clinic building. The most strongest odor was from the kennel and cat boarding room. Study by Reponent et al.,(2010) state

that the presence of odor has been found to correlate well with increased severity of fungal contamination when compared with quantitative polymerase chain reaction (PCR).

Poor ventilation and insulation of the building lead to the increased exposures to bio-aerosol especially molds (Douwes, 2002). The increasing of the bio-aerosol production will increase the exposure of the bio-aerosol to the occupants of the building. The indoor environment could be improved by frequent cleaning and increase the efficiency of the ventilation system in order to remove the contaminants present in the indoor air environment. Based on the study conducted by Zuraimi & Tham (2008) and Frankle et al., (1997) reported that rigorous deep cleaning, wiping of the surfaces, floor cleaning and mopping could reduce airborne bacteria and fungi as much as 40% and 61% respectively.

5.4 The bacteria concentration and fungi concentration in the companion animal clinic

In this study, the average of the bacteria and fungi concentration were collected in a few room at the animal companion clinic. The room was consultation room, surgery room, cat boarding area and also dog boarding area. Overall the highest level of bacterial concentration were at the cat and dog boarding area, followed by waiting area and the surgery room. According to the study conducted by Chuang et al., (2003) shows that the highest bacteria concentration presented in the waiting for hall area (247 ± 4.9). Another significant source of the airborne indoor air is occupants

(Loftness et al., 2007,Stanley at al., 2008). In this study, the result found that,the lowest bioaerosol concentration in the surgery room. This is consistent with the study conducted by Chuang et al.,2003 shows that operation room has lowest bioaerosol concentration because of proper hygienic control and filtration. Low personal allergen exposure in the operation room likely due to more regular and intensive cleaning an less contact with the active animal (Samadi et al., 2013).

5.5 The level of carbon dioxide level, temperature, humidity in the animal companion clinic

A good indicator of proper ventilation is level of CO_2 present in space. Based on the data collected in the companion animal clinic. The result shows most of the companion animal clinic have high level of carbon dioxide, the value nearest 1000ppm and more than 1000ppm. This level of carbon dioxide exceed the limit recommended by Industrial Code of Practice which is 1000ppm. The clinic 14 show the highest level of carbon dioxide compare to the other clinic. The clinic is overcrowding, in unhygienic condition together with odor.

According to the study conducted by Wong and Huang (2004) has found that the level of carbon dioxide of residential bedroom during sleeping hour is higher in air-condition bedroom compared to the bedroom naturally ventilated. This finding indicate that the source of carbon dioxide were comes from the human and also the differences in ventilation performance affect the concentration of carbon dioxide.

Relative humidity and temperature reading collected in each animal clinic show that 43% and 65% of the clinic exceed the recommended limit by the Industrial Code of Practice which is 40-70%. According to the Department of Occupational Safety and Health (DOSH) stated that in order to feel comfortable, indoor temperature should be in between 23-26 degree celcius (℃). ASHRAE Standard 55, indoor humidity level should be monitored between 30-65% for optimum comfort level. Inadequate ventilation, high temperature and humidity can increase concentration of some indoor pollutants(Rawi et al., 2014)

5.6 The association between the respiratory symptom and bioaerosol concentration

Result from Chi-square test reveal that no significant association found between the exposures to the bioaerosol and respiratory symptom ($p > 0.05$). However, in this study the result does not consistent with the study conducted by the Samadi et al., 2013 that shows strongly and positively associated with the prevalence of symptom, including wheezing, wheezing with shortness of breath, asthma attack and itchy red skin (range in OR 2.3-15,$p < 0.05$). According to the Tielen et al., 1996 stated that the most common symptom were cough, nasal, throat and sinus irritation as well as headache after the exposure. WHO has concluded that there is sufficient evidence to show that the occupants of damp or mold building have increased risk of respiratory symptoms,respiratory infection and exacerbation of asthma (Cai et al., 2011 and WHO,1990)

CHAPTER 6

CONCLUSION

High indoor bioaerosol concentration found in the companion animal clinic as mention in the discussion had reflected their state of cleanliness and overcrowd of the building. A few companion animal clinic had been found have bioaerosol concentration exceed the limit and recommended level by ACGIH (1989) and WHO (1990) were 500 CFU/m3 and 1000 CFU/m3 respectively.

Based on the result obtained there is increase in the prevalence of the respiratory symptom among veterinarian including sneezing (50%), stuffed nose (28.6%), headache (19.0%) compared to the study conducted by Tielen et al.,(1996) that showed sneezing (1.2%), stuffed nose (3.6%) and headache (1.2%). In this study, there is no significant association found between respiratory symptom and bioaerosol concentration among veterinary practitioner in companion animal clinic.

. Overall results show the poor indoor air quality in the companion animal clinic and resulted in health problem to the respondents and exposed population.

RECOMMENDATION

Further study on bacterial and fungi bioaerosol that contributes to the health effect should be conducted. It is highly recommended the extensive study should be done to provide more data regarding the bioaerosol exposure level among veterinary practitioner in the companion animal clinic

To assess the respiratory symptom, further study should be done by using another method such as by spirometer to identify the lung function capability of the respondents to identify health risk encountered by the respondent instead of using the only questionnaire. So the result will be more accurate regarding respiratory performance.

Moreover, the companion animal clinic management highly recommended to ensure the efficiency of the ventilation system in each room should be maintained to ensure the clean air provided in the building. Clinic also can install or provide additional air cleaning devices to reduce the contaminants in especially in consultation room,dog and cat boarding room since the level of the bioaerosol higher at this room.

Based on the questionnaire, the question regarding the use of personal protective equipment (PPE) the result show that only a few respondents use the PPE during exposure to the animal. So this indicates that, there low awareness on the used of

PPE while handling the animal. For the recommendation, the animal clinic should provide the bioaerosol training and the importance use of PPE while handling the animal. Recommended PPE are surgical face mask,gloves and appropriate attire. The worker have to wear PPE every time handling animal to reduce the direct contact.

Besides that, the companion animal clinic management has to arrange a routine comprehensive cleaning of each room in the clinic, especially in the dog and cat boarding room. These ways can reduce the concentration of the bioaerosol in the companion animal clinic.

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APPENDIX A

RESPONDENT CONSENT FORM

JAWATANKUASA ETIKA UNIVERSITI UNTUK
PENYELIDIKAN MELIBATKAN MANUSIA (JKEUPM)
UNIVERSITI PUTRA MALAYSIA, 43400 UPM SERDANG,
SELANGOR, MALAYSIA

FORM B1: RESPONDENT'S INFORMATION SHEET AND CONSENT

Please read the following information carefully and do not hesitate to discuss any questions you may have with the researcher.

1. STUDY TITLE

The Relationship between Occupational Exposures to Bio aerosol and Respiratory Symptoms among Veterinary Practitioner in Selangor.

2. BACKGROUND AND PURPOSE OF THE STUDY

Veterinariy practitioner are exposed to many occupational risk either direct or indirect risk. Veterinariry practitioner are those who are handles and usually in contact with the animal. This study will be conducted to assess the prevalence of respiratory symptoms among veterinary practitioner in the animal companion clinic. Otherwise, the study conducted to measure the ventilation performance in the animal clinic.one of the reason is because the present of the bio aerosol in the building will poses harmful effect to the occupants. Decreased performance of healthcare facility HVAC (Heating ventilation air conditioning) systems, filter inefficiencies, improper installation, and poor maintenance can contribute to the spread of health-care–associated airborne infections (HICPAC, 2003). The respiratory symptoms can be developed through the exposure to the bio aerosol during occupational exposures. There's study conducted among pet veterinarian shows the high prevalence of respiratory symptom including rhinitis (69%), cough and chest tightness (53%), wheeze (31%), and wheeze accompanied with airway obstruction (24%).The animal is the source of the allergens that led to the respiratory problem. The study purpose is to identify if there is association between the ventilation performance, bio aerosol exposures and respiratory symptoms.

3. WHAT WILL YOU HAVE TO DO?

If you are agree to be in this study and fufill the inclusive criteria set by the researcher, you will asked to answer a questionnaire- based survey from which will be given by the researcher.The questionnaire is 8 pages related on sociodemographic,respiratory symptoms.

Besides that, your work area will be measured by using instrument to looking at the parameter specified which are biological parameter (fungi and bacteria) and physical parameter (ventilation performance).

You are needed to sign a consent form (respondent) to indicate your interest in this study. Besides that you need to return the consent form to the investigator when answer the questionnaire.

4. WHO SHOULD NOT PARTICIPATE IN THE STUDY?

Pregnant women and person with chronic respiratory symptoms should not participate in this study,

5. WHAT WILL BE THE BENEFITS OF THE STUDY:

(a) TO YOU AS THE SUBJECTS

The study will provide you the result of the concentration of the bioaerosol in your animal companion clinic. Other than that , will be able to know the ventilation performance of the building. Either the ventilation performance is good or efficent enough to remove the contaminant in your building clinic. There is no cost to you for participating in this study as all costs associated with the questionnaire administration will be covered in this study.

(b) TO THE INVESTIGATOR?

This study will help the investigator database on prevalence respiratory symptoms among veterinarian and assist in the developing a checklist to assist the Malaysian authority on veterinary practices in setting-up suitable indoor air system in veterinary practice to ensure the risk to respiratory ill-health have been effectively controlled and reduce.

6. WHAT ARE THE POSSIBLE RISKS?

There is the risk you may find some of the questions about your employment conditions to be sensitive. Apart from that, I do not anticipate any risks to you participating in this study other than those encountered in day to day life.

7. WILL THE INFORMATION THAT YOU PROVIDE AND YOUR IDENTITY REMAIN CONFIDENTIAL?

Any information of the respondents is confidential and the results will be summarized into an outcome collectively as agroup, not individual which may be used in scientific presentation and publication and no identifying information about you will be release.The study information will not be recorded in your occupational medical record. Data may also be tranmitted via the internet,however the data will not consists of identifying information about you will be identified via a unique identification code.To these extents, confidentially is not absolute.The study will not be encrypted.

8. WHO SHOULD YOU CONTACT IF YOU HAVE ADDITIONAL QUESTIONS DURING THE COURSE OF THE RESEARCH?

If you have queries regarding your involvement in this study, please feel free to contact the researcher with the number and email address provided below:

Name	Zulaidah binti Mahmud	Dr. Emilia binti Zainal Abidin (Supervisor)
Department	B.S (Environmental and Occupational Health), Faculty of Medicine and Health Sciences, University Putra Malaysia.	Department of Environmental and Occupational Health, Faculty of Medicine and Health Sciences, Universiti Putra Malaysia.
Contact No.	013-9208905	03-89472643
Email Address	zulaidah.mahmud@yahoo.com	za_emilia@upm.edu.my

Please initial here if you have read and understood the contents of this page

9. CONSENT

I ..... Identity Card No. .....

address.....

....hereby

voluntarily agree to take part in the research stated above *(clinical /drug trial/video recording/ focus group/interview-based/ questionnaire-based).

I have been informed about the nature of the research in terms of methodology, possible adverse

effects and complications (as written in the Respondent's Information Sheet). I understand that I have the right to withdraw from this research at any time without giving any reason whatsoever. I also understand that this study is confidential and all information provided with regard to my identity will remain private and confidential.

I* wish / do not wish to know the results related to my participation in the research

I agree/do not agree that the images/photos/video recordings/voice recordings related to me be used in any form of publication or presentation (if applicable)

* delete where necessary

Signature .....
(Respondent)

Signature .....
(Witness)

Date .....

Name : .....

I/C No : .....

I confirm that I have explained to the respondent the nature and purpose of the above mentioned research.

Date .....

Signature : .....
(Researcher)

APPENDIX B

QUESTIONNAIRE

Respondent ID | | | | | | | APPENDIX II

UPM
UNIVERSITI PUTRA MALAYSIA

Department of Occupational and Environmental Health

Faculty of Medicines and Health Sciences

University Putra Malaysia

QUESTIONNAIRE FORM

OCCUPATIONAL EXPOSURES TO THE BIO-AEROSOL AMONG VETERINARIAN AND ITS RELATIONSHIP WITH RESPIRATORY SYMPTOMS

Please be informed that a study on bio-aerosol exposures and its association with the respiratory symptoms among veterinary doctors is underway. In this regard,please be informed that Sir/Madam has been selected as one of the the respondents in this study.Your help to answer some questions posed in the questionnaire is therefore solicited. All information about individual in particular is kept confidential and only the general information will be used as a result of this study.Your given cooperation is highly appreciated.

Date

		-			-				

PART A : Instruction : Tick (/) in the appropriate box of fill in the appropriate answer.

1.0 SOCIO-DEMOGRAPHIC INFORMATION

1.1 Gender ☐ Male ☐ Female

1.2 Age ☐ Months ☐ Years

1.3 Marital status ☐ Single ☐ Married

1.4 Ethic group ☐ Malay ☐ Chinese ☐ Indian ☐ Others. Please state.....

1.5 Highest level education ☐ STPM ☐ Diploma ☐ Degree ☐ Masters ☐ PhD

1.6 Monthly income ☐ < RM5000 ☐ RM5001-RM7500 ☐ RM7501-RM10000 ☐ RM10001-RM12500 ☐ > RM12501

1.7 Type of household ☐ Apartment/Condominium ☐ Semi-D/Terrace/Bungalow ☐ Others. Please state.....

2.0 SMOKING STATUS		
Instruction : Tick (/) in the appropriate box of fill in the appropriate answer.	**YES**	**NO**
2.1 Are you a smoker? If YES when have you start it Please state ..... **If NO skip to question 2.4**		
2.2 Do (did) you usually smoke? i - cigarettes ii - vape iii- shisha Other (Please state)_____		
2.3 How many cigarette you smoke in day Please state.....		
2.4 Any household members who smokers?		
2.5 Where does the place to smoke at home? Please state.....		

3.0 EMPLOYMENT INFORMATION
Instruction : Tick (/) in the appropriate box or fill in the appropriate answer.
3.1 When did you start working in the current clinic Please state.....
3.2 What is your position in this clinic? Please state.....
3.3 How many occupants are there in the work area? Please state.....
3.4 How long you have work as a veterinary doctor/veterinary practitioner? Please state.....
3.5 How many hours you work in a day? .....hours
3.6 On average,how many days do you work in a week? .....days

3.7 In the previous 3 months,how many you day you miss your work due to illness related to respiratory system? .....days		
3.8 Have you been given a training on th effect of the bio-aerosol and the ways how to control the exposure before this?		
3.9 Do you wear respiratory protective devices such face mask as when handles the animals or when doing treatment to the animal? If YES All over the time Always Seldom		
3.10 What type of respiratory protective devices provided?For example face mask N95, N99 AND others Please state:		
3.11 On average how many times you involved with the animal without wear the respiratory protection devices? Please state.....		

4.0 WORK ENVIRONMENT		
Instruction : Tick (/) in the appropriate box of fill in the appropriate answer.	**YES**	**NO**
4.1 Type of workstation i - Open ii - Closed		
4.2 How is your area air conditioned? i - Central unit ii - Split unit		
4.3 Please indicate if you work with or near the following equipment:- i - Photocopier ii - Computer		

iii - Printer iv - Fax machine		

5.0 HOME ENVIRONMENT		
Instruction : Tick (/) in the appropriate box of fill in the appropriate answer.	**YES**	**NO**
5.1 There is air conditioner in your house?		
5.2 How many hours you use it? Please state:.....hours		
5.3 Do you have and use mechanical ventilation system(extraction of dust/smoke/mist) in your household (e.g exhaust fan)?		
5.4 Do you have any furry pets at your home? **If YES** . What type..... The quantity.....		

6.0 FAMILY HISTORY		
Instruction : Tick (/) in the appropriate box of fill in the appropriate answer.	**YES**	**NO**
6.1 Do your mother have history of asthma?		
6.2 Does your father have story of asthma?		
6.3 Do your mother have history of rhinitis?		
6.4 Does your father have story of rhinitis?		
6.5 Do your mother have history of eczema		
6.6 Does your father have story of eczema?		
6.7 Do you have your history of asthma during youth?		
6.8 Do you have your history of rhinitis during youth?		
6.9 Do you have your history of bronchitis during youth?		

PART B : Respiratory Symptom

7.0 RESPIRATORY SYMPTOMS		
Instruction : Tick (/) in the appropriate box of fill in the appropriate answer.	**YES**	**NO**
7.1 Wheeze and tightness in the chest		
7.1.1. Have you, at any time in the last 12 months, had no yes wheezing or whistling in your chest?		
7.1.2. Have you, at any time in the last 12 months, woken up with a feeling of tightness in your chest first thing in the morning?		
7.2 Shortness of breath		
7.2.1. Have you, at any time in the last 12 months, had an attack of shortness of breath that came on during the day when you were not doing anything strenuous?		
7.2.2 Have you, at any time in the last 12 months, been woken at night by an attack of shortness of breath?		
7.3 Cough and Phlegm from the chest		
7.3.1 Have you, at any time in the last 12 months, been woken at night by an attack of coughing?		
7.3.2Do you usually cough first thing in the morning? If **YES** answer question 7.3.2.1		
7.3.2.1 How many years have you had this cough?		
7.3.3 Do you usually bring up phlegm from your chest first thing in the morning?		
7.3.3.1 Do you have phlegm like this most mornings for as much as 3 months per year?		
7.3.3.2 How many years have you had this phlegm?		
7.4 Animals, dust, feathers		
7.4.1 When you are in a dusty part of the house or with animals (for example, dogs, cats or horses) or near feathers (including pillows and quilts) do you ever:		
a. Get a feeling of tightness in your chest?		
b. Start to feel short of breath?		

7.5 Asthma		
7.5.1 Have you ever had asthma?		
7.5.2 Have you had an attack of asthma at any time in the last 12 months?		
7.5.3 Are you currently taking any medicines (including inhalers, aerosols or tablets) for asthma?		
7.6 Breathing Only check one answer (/)		
7.6.1 Which of the following statements best describes your breathing? i. I never or only rarely get trouble with my breathing ii. I get repeated trouble with my breathing, but it always gets completely better iii. My breathing is never quite right		
7.6.2 Do you have a history of the disease or injuries as stated below? i - previous pulmonary tuberculosis ii - operation on the chest iii - injury on the chest		
7.7 Symptom shortly after the exposure		
7.7.1 Have you had any of these symptom during or shortly after working with the animals i - coughing ii - production of phlegm iii - headache iv - stuffed nose v - sneezing vi - tearing eyes		

7.7.2 Have you had any of these symptoms 4-8 hours after working with the animal? i - coughing ii - production of phlegm iii - headache iv - stuffed nose v - sneezing vi - tearing eyes		

End of the questionnaire

Thanks for your time and attention you have given to this study. Your contribution is greatly appreciated and the information provided will be used to help ensure the safety and health of the those working in the veterinary practice are maintained continuously.

APPENDIX C

APPROVAL TO CONDUCT THE STUDY

APPEMDIX D

CALIBRATION CERTIFICATE OF THE EQUIPMENT

TSI - Customer Service report

Thank you for the opportunity to service your instrument.

RMA Number: 800215326

Ship-to party 11218	Sold-to party 11218
ASEAN SAINTIFIK SDN BHD LOT 2 JALAN 51A/243 PETAL SELANGOR DARUL MALAYSIA	ASEAN SAINTIFIK SDN BHD LOT 2 JALAN 51A/243 PETAL SELANGOR DARUL MALAYSIA

Service Information:

Purchase Order 9857-R
Purchase Order Date 11/15/2011

Description Calibrate Model 7565-X

Equipment 453970 Q-Trak IAQ Meter Only
Serial Number 7565X0914008
Material 7565-X

Service Description:

Return Reason:
CALIBRATION

Findings:
Unit sent in for clean and calibration. As found in tolerance.

Action:
The unit was cleaned, calibrated, and a complete operational checkout was performed.

APPENDIX E

PHOTO ON EQUIPMENT USE IN THIS STUDY

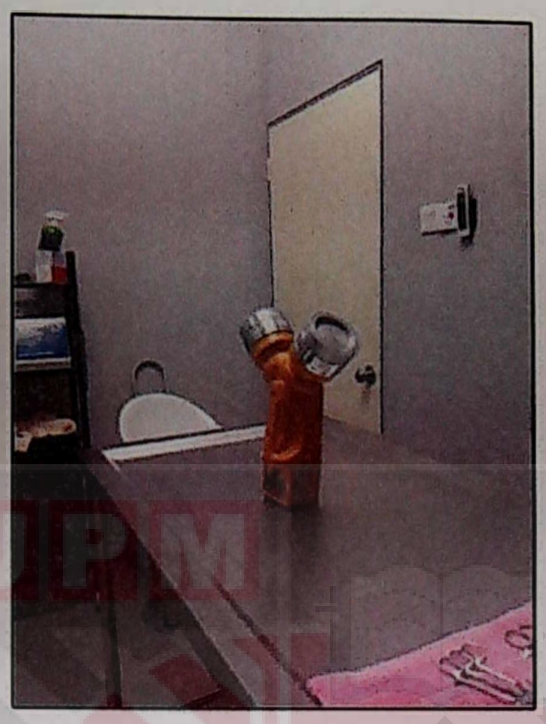


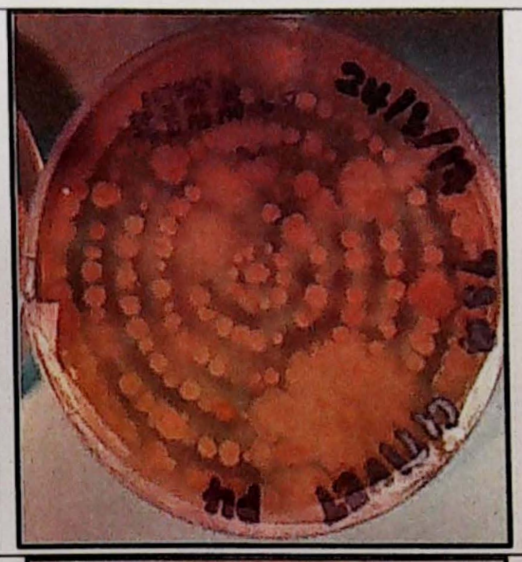
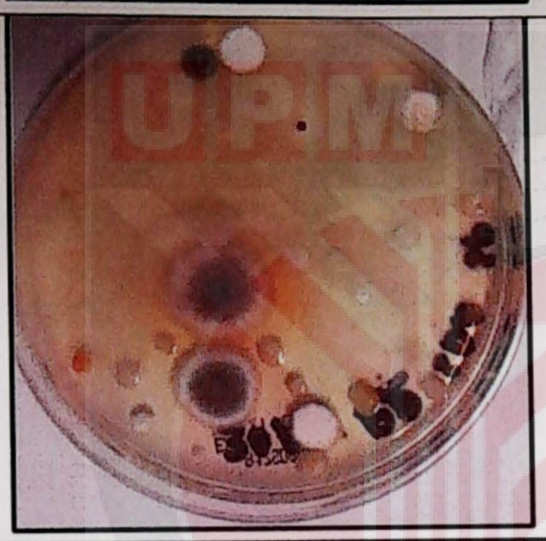
Figure 2 : DUOSAS SUPER 360 for microbiological sampling

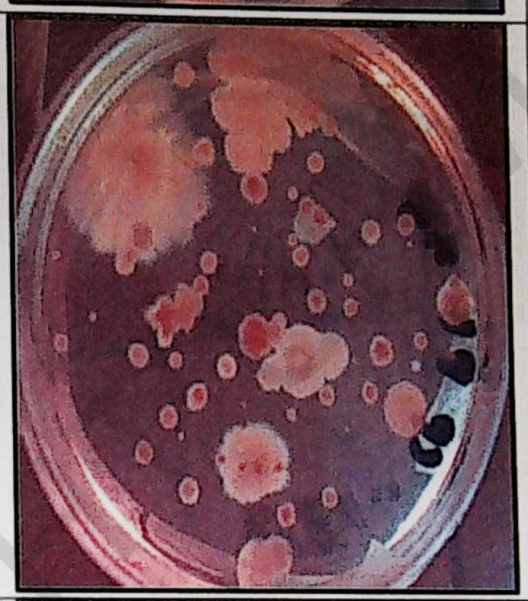
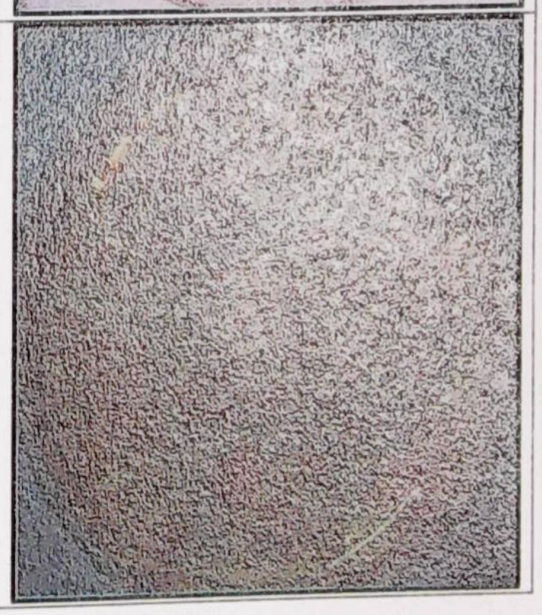
Figure 3 : Q-Track Plus Indoor Air Quality for measurement of carbon dioxide

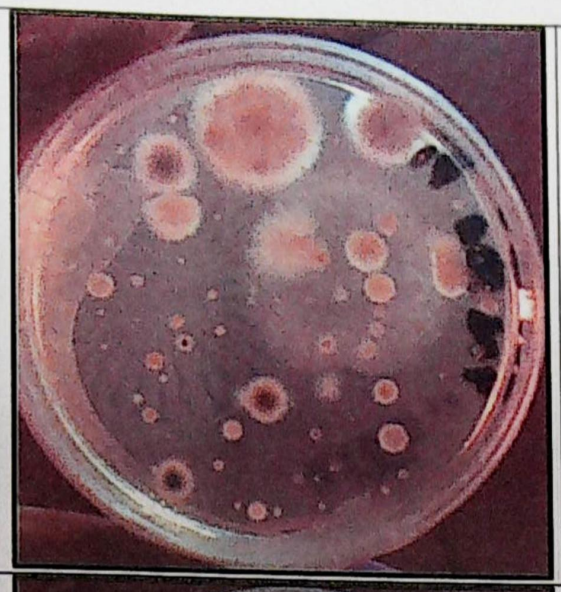
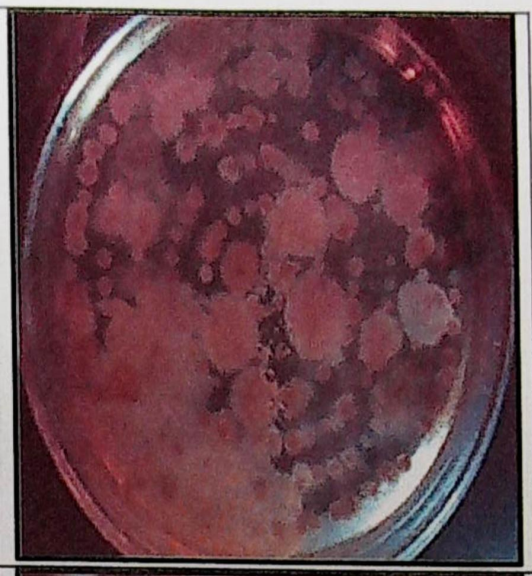
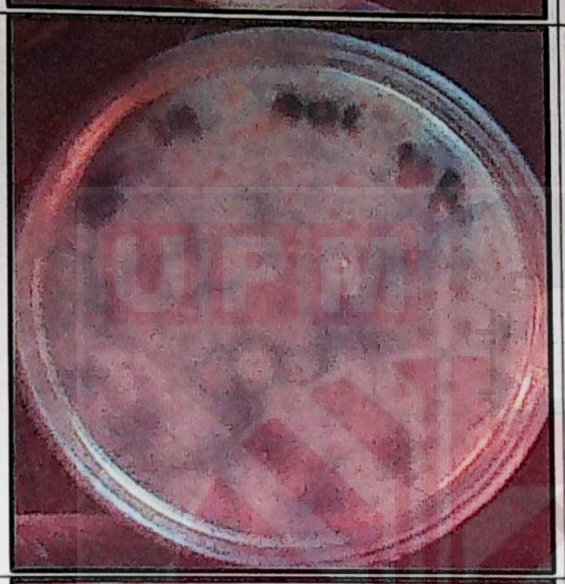
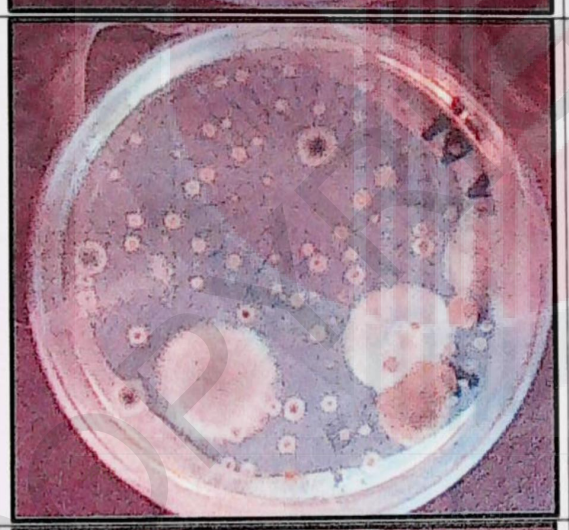
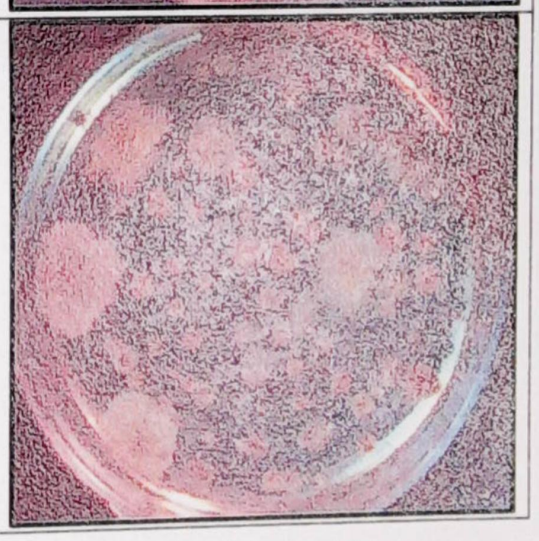
APPENDIX F

RESULT OBTAIN FROM THE MICROBIOLOGICAL SAMPLING

Table 4.9 The sample of bioaerosol concentration in animal companion clinic.

Clinic 1	Fungi	Bacteria
		
Clinic 2		
Clinic 3		

Clinic 4		
Clinic 5		
Clinic 6		
Clinic 7		

Clinic 8		
Clinic 9		
Clinic 10		
Clinic 11		

Clinic 12		
Clinic 13		
Clinic 14