

IMPROVING INDOOR AIR QUALITY FOR PREVENTING TRANSMISSION OF COVID-19 AT BACTIGUARD MALAYSIA SDN. BHD AND BACTIGUARD SOUTH EAST ASIA

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Article History

Received:
September 26, 2023

Received in revised form:
April 8, 2024

Accepted:
April 15, 2024

Published Online:
June 20, 2024

Abstract

According to the World Health Organization (WHO), Covid-19 was regarded as a pandemic in the year 2020. However, the status eventually changed to endemic in 2022 since there are still until now, cases being reported in daily basis, but mostly those infected persons will only experience reversible health effects, with almost none resulting to death after all countries applied the vaccination and booster program including Malaysia. Covid-19 spread mostly by close contact and respiratory droplets. Covid-19 is a viral transmission via small airborne microdroplets or known as 'aerosols'. According to current information on the airborne transmission of SARS-CoV-2, inhalation at distances greater than 1-2 m from an infected source can lead to transmission. As a result, optimising ventilation and air quality in indoor areas is crucial to reducing this risk of airborne transmission, especially in workplace. Appropriate ventilation distribution ensures that appropriate dilution is achieved. Filtration is the most effective way for HVAC systems and small particles are removed most effectively by HEPA filters. The purpose of this research was to analyse potential transmission of Covid-19 at Bactiguard Malaysia Sdn. Bhd. and Bactiguard Malaysia South East Asia. The research was equipped with survey questionnaire to assess employee knowledge and awareness against transmission of Covid-19 by offering insight of indoor air properties that can be adapted at Bactiguard Malaysia Sdn. Bhd. and Bactiguard South-East Asia based on statistical analysis performed using SPSS statistical analysis, risk assessment and documentation for continuous monitoring of Covid-19 transmission rate. There are three important findings in this study: (i) The effective indoor air quality comprises of proper ventilation system and engineering control to prevent the spread of Covid-19 as well as other airborne contaminants. (ii) Engineering control is beneficial in terms of isolate employees from hazard and essential to protect employees from Covid-19. (iii) Risk assessment is essential to ensure hazard is being identified and appropriate control measures is taken as well as implemented to control the transmission of Covid-19.

Keywords: Covid-19; airborne; transmission; ventilation; indoor air.

1.0 INTRODUCTION

Ventilation regulates the rate at which room air is withdrawn and replaced over time. By using suitable filtration systems, ventilation is vital to remove pollution from external air before bringing it into a building. Ventilation is essential in removing exhaled virus-laden air by reducing total concentration that is inhaled by occupants. According to United State Environmental Protection Agency (2021), Indoor Air Quality (IAQ) is defined as the air quality inside and around buildings and structures, particularly as it relates to occupant health and comfort. Understanding and eliminating common indoor contaminants can help you lower your chance of developing indoor health problems. Covid-19 is spread via airborne particles and droplets. When people with Covid exhale, they can discharge particles and droplets of respiratory fluids containing the SARS CoV-2 virus into the air. These minute droplets carry the virus and particles continue to spread infection when they aggregate in the indoor air of room or space. A heating, ventilating, and air conditioning (HVAC) system provides ventilation air in a mechanically ventilated building.

As a Small Medium Enterprise (SME), the pandemic issue had really impacted the company a lot especially in protecting the workers from a potential infection to the Covid-19 virus due to transmission upon working in an indoor (enclosed) working area. The area of study was Bactiguard Malaysia Sdn. Bhd. as an overall and comprised of both plants. Since the transmission of the virus in Malaysia was reported to be considerably concerning at workplaces especially at the end of 2021 (Shanmugam et al., 2020), many industries or companies were required to shut down for a period of two weeks, hence affecting the productivity and business operation. Due to poor indoor air quality in many companies especially the SMEs, this study will investigate the effectiveness of the current measures taken by companies to reduce the risk of airborne transmission example through ventilation system, besides other non-engineering approaches which include practicing social distancing by one metre distance, measuring body temperature, Covid-19 self-test examination using kit and wearing suitable mask. As mentioned above, the study will be conducted particularly at Bactiguard Malaysia Sdn. Bhd.

This study focuses on the methods to minimise indoor transmission of Covid-19, which is transmitted primarily through inhalation of aerosol droplets exhaled by infected people and determining the appropriate ventilation system that is required in a workplace based on the space, number of occupants, and working hours that is important to prevent virus transmission. The type of ventilation and modification suitable at workplace will also be assessed to convince employer in determining the ventilation system (Stephanie Balgeman, Ben Meigs, Stephan Mohr, Arvid Niemöller, 2020). The area of study covers the main office and quality office at Bactiguard Malaysia Sdn. Bhd. where most employee spend most of their time while working. To avoid substantial drawbacks in industry operations in the future, engineering controls that contribute to low risk of airborne transmission, viruses and all types of respiratory infections will be covered in the study. The idea will be an added value for an industry to prepare in advance for any pandemic situation not limited to Bactiguard Malaysia Sdn. Bhd. through survey questionnaire to assess knowledge pertaining transmission of Covid-19 and risk assessment to address the risk of transmission as well as control measures. The research focus to address indoor air quality perspective to prevent the transmission of Covid-19 at Bactiguard Malaysia Sdn. Bhd. that is limited to small medium enterprise (SME) whereby the risk of transmission is low since the number of employees is less and transmission of COVID-19 can be easily controlled.

The world is currently moving towards the endemic of Covid-19 that is, to live with it with proper SOPs taken (Guidelines, 2007). Therefore, it is highly important to enhance the quality of air at workplace to prevent the transmission of this respiratory pathogens within the working environment at Bactiguard Malaysia Sdn. Bhd. since employees spend average of 8-12 hours per day at work. The extent of the study will cover the advantage of High Efficient Particulate Air Filter (HEPA) to lower transmission risk of Covid-19 similar to the application adapted in healthcare facility. The study will encourage employers to improve indoor air

quality at Bactiguard Malaysia Sdn. Bhd. to protect employees with respiratory diseases and the elderly employee who are vulnerable to poor indoor air quality, as they are the groups most likely to acquire significant symptoms from the new coronavirus. Symptom flare-ups may necessitate a trip to the hospital, which increases chance of contracting the new coronavirus or other illnesses such as the flu among employees. For employee in vulnerable populations, proper indoor air quality is critical during this latest coronavirus outbreak. This is an important measure to curb the spreading of deadly virus among employee and may significantly reduce transmission rate when less employees are being infected and in return can ensure business continuity.

There were three research objectives in this study which aim to figure out the effectiveness indoor air quality that is suitable to prevent the spread of Covid-19 at workplace through proper ventilation system and engineering control that will be beneficial as long-term solution for Bactiguard Malaysia Sdn. Bhd. and all industry in Malaysia. This will reduce the frequency of industry being shut down due to Covid-19 infection among employees. A comprehensive risk assessment was constructed pertaining indoor air quality based on survey questionnaire outcome which will be then documented as a guideline to improve or implement effective indoor air quality at workplace to reduce infection rate of Covid-19 among workers.

2.0 METHODOLOGY

Bactiguard is a Swedish based medical device company located at Senai, Johor Bahru and Bukit Minyak, Penang. The headquarters is located at Stockholm, Sweden. Bactiguard Malaysia Sdn. Bhd. was set up in January 2012 and their main activities were involving coating of Bactiguard Infection protection (BIP) Foley catheter that prevents healthcare associated infections in the urinary tract and the bloodstream. Bactiguard Malaysia Sdn. Bhd. products include BIP latex, silicone and TempSensor catheters whereas Bactiguard Sweden manufactured BIP Central Venous Catheter (CVC) and Endotracheal Tubes (ETT). Bactiguard South East Asia Sdn. Bhd. or Bactiguard SEA operates a contemporary ISO class 8 production plant in Penang. Bactiguard SEA has a diverse range of products, especially in the areas of wound care and infection control. Sutures, hernia mesh, HYDROCYN aqua®, a revolutionary wound wash, debridement agent, and cleaning solution for acute and chronic wounds, as well as Bactiguard-coated orthopaedic trauma implants, are all part of the product line

The selection of the research topic was done based on the problem statement which was identified from an actual workplace of the researcher. Based on the research gap identified from the problem statement, it was apparent for the company to conduct the indoor air quality study and specific operational guidelines to effectively prevent the transmission of Covid-19 among employees in the company. The study started with pilot study by involving 30 respondents to check the reliability of the items included in the questionnaire design of survey questionnaire as described in Section 2.3, questionnaire was developed using google form and distributed to the respondent through walk in and social messaging platform as described in Section 2.4, data analysis using SPSS statistical analysis was conducted and risk assessment conducted as part of documentation in order to access all the risk and control measure recommended as per section 2.6. From the outcomes of the investigation, the best practice to prevent the transmission of Covid-19 at workplace were recommended with a dedicated focus being put to increase the indoor air quality aspect in the company.

2.1 Research Flow

In this study, three main phases were designed in the methodology to achieve the objectives of the study which were survey questionnaire, data analysis and risk assessment documentation. Based on the flowchart, there were 12 critical steps computed to be the important steps in this methodology. The overall methodology was presented as a flowchart as shown in Figure 1 below:

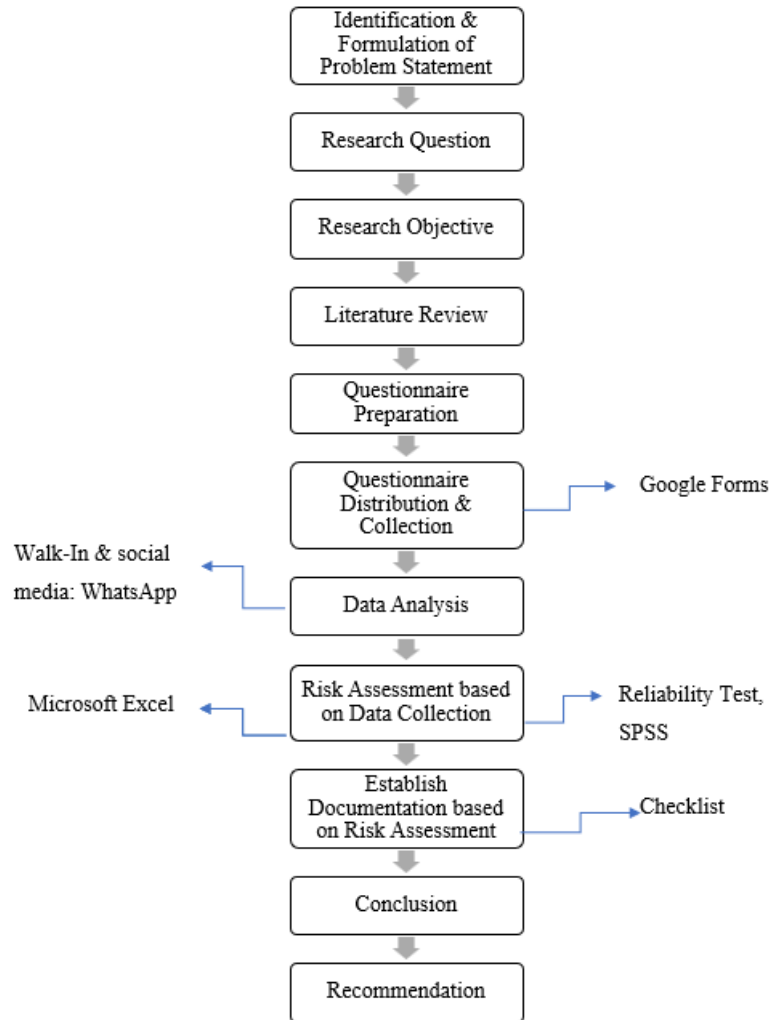


Figure 1. Flow Chart of Methodology.

2.2 Research Design for Data Collection

The data collection for this research work was conducting a survey using questionnaires to evaluate the knowledge and understanding of indoor air quality that is related to the transmission rate of Covid-19 and followed by risk assessment which was documented as guideline for Bactiguard Malaysia Sdn. Bhd. as well as other industry.

The study begun with a pilot study by involving 30 respondents to check the reliability of the items included in the questionnaire before moving on with the actual distribution of the questionnaire. Pilot study enables any issues with the questionnaire to be addressed well before it is distributed and analysed. During the pilot study, troubleshooting can be used to identify and subsequently revising the problematic items in the questionnaire, removing redundant questions, as well as those questions that are difficult to comprehend or ambiguous.

2.3 Components of the questionnaire

The questionnaire basically comprised of six different sections. Section 1 was intended to collect the demographic information; Section 2 was to assess the awareness of respondent towards Covid-19 and Section 3 was to collect information regarding airborne transmission of Covid-19. Section 4 was intended to collect information regarding ventilation system, Section

5 was to obtain information regarding air circulation and Section 6 was to obtain information on engineering control from respondent in order to prevent the transmission of Covid-19 (Jaber et al., 2021).

The questionnaires were constructed by referring to journals and established websites. The questionnaire was developed using google form and distributed to the respondent through walk in and social messaging platform. Data collection will be done at a single point in time, which means on the same day and time to ensure accuracy of the data obtained. The data obtained was assessed by checking the reliability and clarity of the questionnaire. Spearman’s rank order correlation was used to determine the questionnaire's correlation for ordinal and categorical data respectively.

The types of data variables utilised in the questionnaire were categorical types of data variables for section 1 to collect demographic information from respondents, and ordinal type variables for sections 2 to 6 to assess respondent’s awareness regarding indoor air quality pertaining the transmission of Covid-19. The summary of the sections in the questionnaires as tabulated in **Table 1**:

Table 1. Design of Survey Questionnaire

Section	Contents	Number of questions
Section 1	Demographic Information	7
Section 2	Awareness of Covid-19 Virus	5
Section 3	Airborne Transmission of Covid-19	5
Section 4	Ventilation System in Indoor Air	7
Section 5	Air Circulation and Airborne transmission of Covid-19	2
Section 6	Engineering Control	5

2.4 Data Analysis

The research data was processed and presented in graph and tabular form using Microsoft Excel to illustrate the frequency distribution of the result obtain and SPSS 26 software. Correlation tests will be conducted using SPSS software. The data collected will be then computed accordingly in SPSS 26 software. Statistical evaluation was computed using correlation coefficient (Sheskin et al., 2000).

The Spearman rank-order correlation coefficient or also known as Spearman's correlation is a nonparametric measure of the strength and direction of relationship between two variables assessed on an ordinal scale. A Contingency coefficient is to determine if the two sets of data is independent and to test for the reliability of the questionnaire. The chosen statistical tool will be used to analyse the association between dependent variable (construct) and the independent variable for example, the awareness of employees of Bactiguard Malaysia Sdn. Bhd. between the relationship pertaining the transmission rate of Covid-19 (Sheskin et al., 2000).

2.5 Risk Assessment

The objective of the Risk Assessment conducted in this study was to assist Bactiguard Malaysia Sdn. Bhd. in determining the potential risk level in terms of Covid-19 transmission among workers. The Risk Assessment will be conducted based on ‘Guidelines To Conduct A Risk Assessment To Determine The Risk Status Of Workplaces For Covid-19 Testing’ by the Ministry of Health Malaysia (Penyakit, 2021).

Referring to the indicator guidelines, two main indicators were used, risk factor and existing control measures as per **Figure 2**. Risk factors were all the factor related to potential risk of transmission and exiting control measures were related to the steps taken to curb the potential risk of transmission. The risk assessment will address the requirement of indoor air quality from questionnaire in the checklist besides assessing the risk factor and control measure in the

checklist. Then, the risk level will be determined using a score method provided in the guideline as well. A total score of below 60% will be categorised as high risk with respect to the control measures aspect, meanwhile a total score above 60% will be categorised low risk.

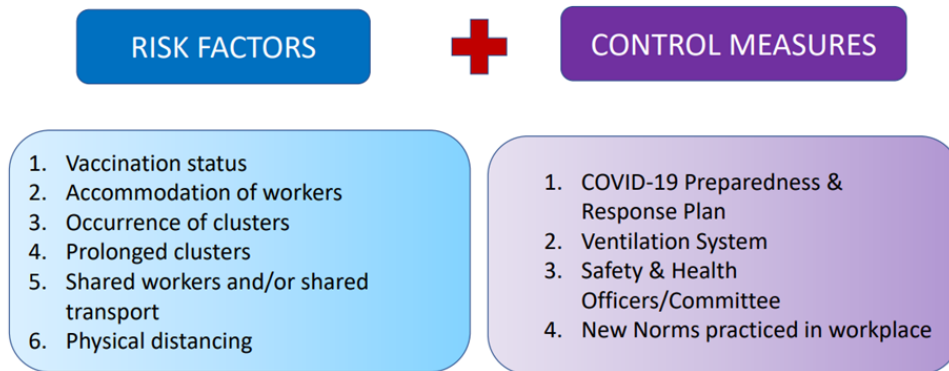


Figure 2. Indicators for assessing risk of Covid-19 transmission at workplace (Penyakit, 2021).

2.6 Documentation of Risk Assessment

All the risk assessed, together with the control measures recommended or currently available in Bactiguard Malaysia Sdn. Bhd. will be documented for future reference. Through documentation, the aspect of maintenance and inspection related to engineering control can be enhanced further through records and evidence. This is to establish a documented procedure pertaining to indoor air quality activity to prevent the spreading of deadly virus.

3.0 RESULTS AND DISCUSSION

3.1 Reliability test

Cronbach's Alpha was used to assess the consistency of the scales that represent the independent and dependent variables. Cronbach Alpha levels greater than 0.7 are deemed more dependable than values less than 0.7 (Nunnally, 1978).

The reliability Cronbach's Alpha values for the pilot study were obtained as presented in **Table 2**. There were two main subtopics of the questionnaire components, ventilation system in indoor air as well as air circulation and airborne transmission of Covid-19 showed Cronbach's Alpha value less than 0.7, which is 0.463 and 0.460 respectively. Therefore, the questionnaire components were modified (n =19) by using SPSS. The modification was automatically performed by SPSS software upon the identification of components with zero variance and covariance that cannot be computed. Hence, the improved overall Cronbach's Alpha obtained was 0.761, indicating now the questionnaire is reliable.

Table 2. Reliability statistics Cronbach's Alpha.

Contents	Number of Items	Cronbach's Alpha
Awareness of Covid-19 Virus	5	0.728
Airborne Transmission of Covid-19	5	0.757
Ventilation System in Indoor Air	7	0.463
Air Circulation and Airborne transmission of Covid-19	2	0.460
Engineering Control	5	0.741

3.2 Risk Assessment Study

A detailed risk assessment study conducted was aimed to provide information to help Bactiguard Malaysia Sdn. Bhd. to assess the possible risk of COVID-19 transmission among employees based on ‘Guidelines To Conduct A Risk Assessment To Determine The Risk Status Of Workplaces For Covid-19 Testing’, published by the Ministry Of Health Malaysia, MOH (Penyakit, 2021). Based on Section 18 of the Malaysian Occupational Safety and Health (Amendment) Act 2022, the act asserted that employers were accountable for the welfare, health, and safety of their workers. As a result, the act stated that in order to determine the need for testing, employers were to assess the risk in the workplace which is aligned with the Act 342, Prevention and Control of Infectious diseases Act 1988. Each workplace's risk status is different and depends on a variety of factors.

Thus, the mentioned guideline which was made public by the OSHA Act 2022 was intended to help organizations to implement COVID-19 exposure assessment through a list of indicators that describe the risks and safeguards to stop COVID-19 transmission at workplace. Once the assessment result was obtained, suitable control measures can be implemented by the employers of Bactiguard Malaysia Sdn. Bhd.

Using the assessment checklist (**Table 3**), the Human Resource representative or Safety Coordinator of Bactiguard Malaysia Sdn. Bhd. were assigned as the person responsible to conduct the assessment in every two weeks basis. The employer should include a tick (√) for a YES response to any of the indicators and cross (X) for a NO response for each indicator. If an indicator is deemed pointless, the indicator should be eliminated entirely from the list by that is, remove it from the denominator. The scoring system were determined based on the YES responses count and NO responses count that will be the final score which defines risk level. The final score of more than 60% is considered low risk whereas the final score of less than 60% is considered high risk as indicated in **Figure 3**.

Table 3. Contents of Risk Assessment Checklist.

NO.	Risk Factors	✓/x/NR
1.	Is the vaccination status of employers and employees ≥ 90%?	
2.	Absence of cluster in the workplace as declared	
3.	Cluster in the workplace is controlled within 28 days	
4.	No shared workers and/or shared transport	
5.	Ability to maintain physical distancing of 1 meter in work area/ workstation	
	Risk Factors	✓/x/NR
6.	COVID-19 preparedness and response plan available	
7.	Ventilation system maintained as per manufacturer’s schedule	
8.	New norms are practiced at the workplace- Public Health & Social Measures (e. g. mask usage, hand hygiene, temperature screening on entry, staggered break times, Covid-19 Self test every 2 weeks)	
9.	Presence of Safety and Health Coordinator	

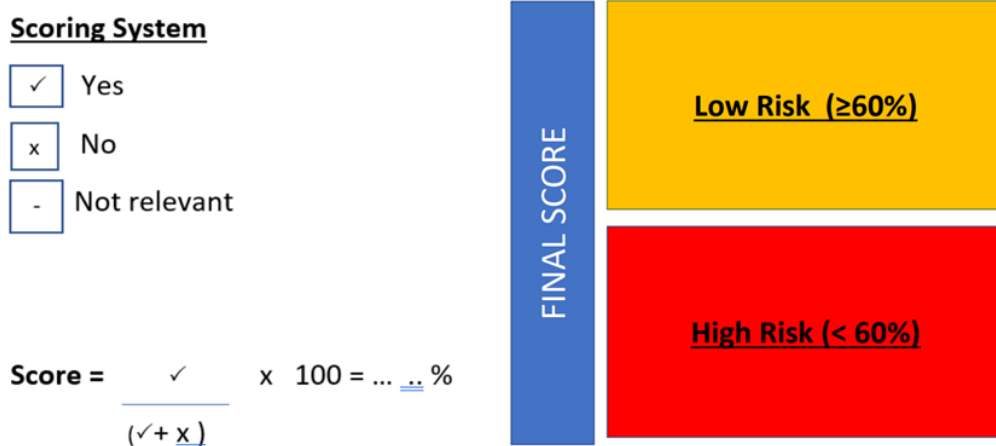


Figure 3. Final Scoring system that defines risk level (Penyakit, 2021).

3.3 Risk Assessment Framework

The content of the risk assessment below (**Table 4**) is adapted from ‘Guidelines To Conduct A Risk Assessment To Determine The Risk Status Of Workplaces For Covid-19 Testing’, published by the Ministry Of Health Malaysia (Penyakit, 2021). The likelihood rating and severity rating that defines the risk rating is similar to HIRARC by DOSH as per **Appendix A**.

Table 4. Risk Assessment Proposal

Name of Organization		Date of Assessment							
Name of Assessor		Supporting Documents							
Name of Person In Charge									
Person at risk									
COVID-19 SPECIFIC RISK ASSESSMENT FOR BACTIGUARD MALAYSIA SDN. BHD.									
Hazards Identification			Risk Analysis			Risk Control			
Hazards	Potential Risks	Risk Rating (L x S = R)			Existing Control Measures	Risk Rating (L x S = R)			Recommended Control Measures
		L	S	R		L	S	R	
Unvaccinated / incomplete vaccinated employees	Unvaccinated employees or incomplete vaccinated employees are easily susceptible for infection. They should be closely monitored by assessing their health conditions.	5	5	25	- Administrative control/ Vaccination arrangement: Human Resource management must make sure employees are completed vaccinated. Necessary arrangement must be done to ensure all employees are being vaccinated.	2	2	4	- Administrative control: Update Human Resource policy to include Covid-19 vaccination requirement and status for existing and new hiring employees - Administrative control: Employees vaccination status were documented and archived by the Human Resource management. - Administrative control: Conduct training to ensure all employees are aware pertaining the updated procedure.
Symptomatic employees / elderly employees	Employees who are showing symptoms should be isolated especially from elderly employees as those who are aged have lower immune system and easily prone to infection.	5	5	25	-Isolation: Those who are showing Covid-19 symptoms must be isolated to limit Covid-19 infection at workplace. - Administrative control/ Health check: Human resource management must be able to inform respective supervisor regarding employees' health conditions in order to assign work arrangement.	2	2	4	- Administrative control: Update standard work procedure to include isolation procedure. - Administrative control: Human resource management should ensure employees who are not well being treated at panel clinic. - Administrative control: Conduct training to ensure all employees are aware pertaining the updated procedure.
Shared accommodation / transportation	Employees' places of residence /transportation	4	4	16	-Elimination/ Situation declaration: In the event of any family	2	2	4	- Administrative control: Update standard work procedure to include

	were evaluated to see whether they were residing with high-risk family members, such as elderly or young children, or whether they were in a hostel or dormitory.				member’s or employee residing in the same house were being infected, employee need to declare to Human resource management. -Substitution/ Work arrangement: If necessary, the employee can work from home if has symptoms and if no symptoms, employee can come to work after performing Covid-19 self-test and wear mask.				accommodation issue procedure. - Administrative control: Conduct training to ensure all employees are aware pertaining the updated procedure.
Cluster’s occurrence / prolonged cluster	Cluster of Covid-19 increases the chain of infection rate in the organization very fast. Close contacts among employees’ should be determine in order to break the chain of infection in the organization.	5	5	25	Substitution / Cluster Identification: If there was any cluster among employees and determine the sources of the infection. Assess if Covid-19 cluster was present after 28 days in the organization and if yes, Safety Coordinator shall inform the Ministry of Health and the employees should be refrained from entering workplace and must be treated. -Elimination: Sanitization of workplace must be arranged.	2	3	6	- Administrative control: Update standard work procedure to include cluster identification and sanitization activity when needed. - Administrative control: Conduct training to ensure all employees are aware pertaining the updated procedure.
Physical distancing not exercised	Increases the risk of Covid-19 transmission at workplace when infected employee interacts with other employees	3	3	9	-Administrative control: Ensure employees adhere closely to physical distancing by arranging lunch hour by section and having chairs as well as floor being marked with 1m distancing indicator. -PPE: Wearing of mask is a must to ensure Covid-19	2	2	4	-Administrative control: Update standard work procedure to include 1m physical distancing. - Administrative control: Conduct training to ensure all employees are aware pertaining the updated procedure.

					transmission rate is being controlled.				
Air in the work area is being polluted by particles, air being recirculated or absence of filter in the air conditioning system	Increase the risk of Covid-19 transmission due to insufficient indoor air quality	5	5	25	-Engineering control: Filters such as HEPA filters can be installed in air conditioner to ensure particles being removed efficiently. Air conditioning system should be in the turn off mode for circulation. Air purifier can be installed in office for better ventilation.	2	2	4	- Administrative control: Update standard work procedure to include method to improve ventilation for better indoor air quality. - Administrative control: Conduct training to ensure all employees are aware pertaining the updated procedure.

3.4 Summary of the findings of the study

In a nutshell, employees of Bactiguard Malaysia Sdn. Bhd. were all knowledgeable and have awareness regarding the importance aspect of Covid -19 such as symptoms of the virus, nature of the virus and fast spreading nature of the virus. Besides that, employees were seen to have high understanding and awareness related to the transmission route of Covid-19, airborne droplets and the precautionary measures that must exercise in order to reduce the risk of being infected.

However, about 50% of Bactiguard Malaysia Sdn. Bhd. employees were seems to have less understanding and knowledge pertaining the topic of ventilation system and air circulation as this topics required high level of understanding with engineering and mechanical background. Hence, the employees should be equipped of the knowledge related to the topic in order to ensure they have the basic understanding regarding the topic.

Checklist based risk assessment is a simplified and modified method of risk assessment approach to encourage organization such as Bactiguard Malaysia Sdn. Bhd. to identify the hazard related to Covid-19 transmission and the necessary as well as suitable control measure to be implemented in order to combat the spread of Covid-19 at workplace. The hazards and control measures should be documented as a safe operating procedure before initiating training to all employee of Bactiguard Malaysia Sdn. Bhd.

4.0 CONCLUSION

Based on the first objective, the effective indoor air quality comprises of proper ventilation system and engineering control to prevent the spread of Covid-19 as well as other airborne contaminants. Employer is advised to install air purifier equipped with High efficiency particle air (HEPA) filter which is the best or air purifier with minimum efficiency rating value (MERV) 16 filter in the office area to reduce airborne particulates in the air that is responsible for airborne diseases such as Covid-19, Influenza and allergy. The filter is responsible to remove airborne particles such as dust, bacteria and viruses that ensures the indoor air quality is being free from pollutants and reduces infection among employees. Regular maintenance, trice a month or twice a year for control environment such as cleanroom is sufficient to ensure the quality of air is maintained.

Appropriate engineering control is essential to prevent the spread of Covid-19 and other airborne diseases. Engineering control such as wearing a proper face mask, sanitation activity, ensuring social distancing of 1 meter as well as health declaration verification by employee and Covid self-test for those employees who are not well are all the necessary control measure to prevent the transmission of

Covid-19. Bactiguard Malaysia Sdn. Bhd. should ensure engineering control is done as per scheduled despite the situation of Covid-19 to prevent any alarming situation such as sudden spike in Covid-19 cases. Engineering control is beneficial in terms of isolate employees from hazard and essential to protect employees from Covid-19.

Risk assessment is essential to ensure hazard is being identified and appropriate control measures is taken as well as implemented to control the transmission of Covid-19. The checklist form of risk assessment is very user friendly and saves time as compared to the HIRARC method. Bactiguard Malaysia Sdn. Bhd. should conduct risk assessment and document the proposed control measure as a standard work procedure as part of administrative control which will be beneficial when employees are being informed pertaining all the hazard as well as control measure to combat the transmission of airborne diseases not limited to Covid-19.

Acknowledgment

The authors would like to acknowledge the Universiti Teknologi Malaysia (UTM) for the technical, administrative and the financial support.

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Appendix A Risk Assessment Matrix Definition

(a) Likelihood (L)

- 5 - Most Likely (The most likely result of the hazard / event being realized)
- 4 - Possible (Has a good chance of occurring and is not unusual)
- 3 - Conceivable (Might be occur at sometime in future)
- 2 - Remote (Has not been known to occur after many years)
- 1 - Inconceivable (Is practically impossible and has never occurred)

(b) Severity (S)

- 5 - Catastrophic (Numerous fatalities, irrecoverable property damage and productivity)
- 4 - Fatal (Approximately one single fatality major property damage if hazard is realized)
- 3 - Serious (Non-fatal injury, permanent disability)
- 2 - Minor (Disabling but not permanent injury)
- 1 - Negligible (Minor abrasions, bruises, cuts, first aid type injury)

(c) Hierarchy of Control

- 1 - Elimination
- 2 - Substitution
- 3 - Isolation
- 4 - Engineering Control
- 5 - Administration Control
- 6 - Personal Protective Equipment (PPE)

(d) Risk Level (R)

1-4 (Low)
5-12 (Medium)
15-25 (High)