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COVID-19 STANDARD OPERATING PROCEDURE ADVANCEMENT FOR OFFICE BUILDING USING INDOOR ENVIRONMENTAL QUALITY ELEMENTS

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Abstract

COVID-19 guideline is expected to be part of the 'new norms' for workplace. However, regarding COVID-19 Standard Operating Procedure (SOP) issued by Ministry of Health Malaysia, there is inadequate concentration on Indoor Environmental Quality (IEQ) parameters even it has been proven in various research that COVID-19 transmission spread actively in indoor environment and green elements could mitigate the virus transmission. Therefore, this study aims to enhance existing COVID-19 SOP by discovering sustainable COVID-19 framework for office building. Sets of questionnaires is distributed among employees at Menara Majlis Bandaraya Johor Bahru, Malaysia and analysed using Frequency Analysis and Cross Tabulation Analysis. Overall, result shows that EQ7 Air Change Effectiveness is the most important IEQ parameters that can be selected to improve the current COVID-19 SOP. This study is significant for building manager in workplace to enhance their current SOP by adding green elements which is IEQ parameters to reduce COVID-19 spread in workplace.

Keyword: Office Building, COVID-19, Standard Operating Procedure, Indoor Environmental Quality

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INTRODUCTION

On late December 2019, the world has encountered by a new issue that caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) or namely as the Coronavirus Disease 2019 (COVID-19) which could give impact to people's health. It was discovered in Wuhan, China and has been rapidly spread to entire world (Zhou et al., 2020; Kabir et al., 2020), eventually could cause to death.

As of 18th March 2020, Malaysia reported over 700 confirmed cases which forced government to implement Movement Control Order (MCO) to reduce the COVID-19 transmission. However, the implementation of the Movement Control Order (MCO) has led to almost 50% of self-employed Malaysians have lost their jobs due MCO. According to the Labour Force Survey conducted by Department of Statistics Malaysia (DOSM) in March, it was found that 46.6% of self-employed respondents had reported losing their jobs following COVID-19 and MCO being enforced. Besides, the highest unemployment in 2020 was recorded which is achieved at 5.3%.

Due to the highest unemployment rate during MCO enforcement, government has issued a new regulation in May 2020 where include office sector started to open. However, employee is compulsory to comply with Standard Operating Procedures (SOP) issued by Ministry of Health Malaysia (MOH) where in workplace, they need to wear face mask, frequent hand washing or hand sanitiser, regular cleaning, and disinfection surface, avoid handshaking, avoid public spaces and crowds, avoid meeting in large scale size, and so forth. In spite of that, researchers from past pandemic believes that measurement control related to physical distancing, avoiding public meetings, isolating the diseased, and wearing face mask are the most successful measures to slow down the spread of pandemics (Peeri et al., 2020; Vaka et al., 2020).

Since World Health Organization (WHO) acknowledge that the coronavirus airborne transmission could be potentially indoors with crowded and poorly ventilated rooms which eventually required people to isolate themselves during lockdown, the COVID-19 SOP is expected to be part of the 'new norms' for workplace. Pertaining to the existing COVID-19 guideline, there are several researchers suggest that green measurement would also ensure the long-term environmental protection (Bashir et al., 2020; Bogoch et al., 2020) as many people spend approximate 90% of their daily life indoors.

In this crisis environment, recent researcher believes that environmental factors in buildings, including temperature, humidity, and ventilation and filtering systems by referring to indoor environmental quality criteria could leverage the gaps (Pinheiro & Luis, 2020). Dietz (2020) analysed that feature such as ventilation and indoor air quality, lighting, and the deposition on the surfaces of materials are several aspects that should be focused on in minimising the spread

of COVID-19 inside buildings. On top of that, in previous study by Chan et al., (2011) claimed that high temperature at high relative humidity have stimulating impact on coronavirus inactivation, while lower temperatures and low humidity could enable the long-term existence of the virus on contaminated surfaces. However, by reviewing to COVID-19 SOP issued by MOH, there is inadequate concentration on Indoor Environmental Quality (IEQ) parameters even it has been proven in various researches that the transmission of COVID-19 virus actively occurs indoor environment and IEQ could mitigate the virus transmission.

Mofijur et al. (2021) has mentioned that governments, policy makers, and stakeholders is required to come up with necessary steps by focusing on the future building sustainability as indoor built environment plays a critical role in our overall well-being. Hence, in order to deal with COVID-19 pandemic, matters associated with the advancement of COVID-19 SOP are taken into considerations by integrating IEQ parameters with existing COVID-19 guideline to prevent the COVID-19 spread as employee is still required to adhere to SOP and adapt a 'new norm' environment in their workplace.

Therefore, the aim of this study is to discover a sustainable COVID-19 framework for office building which not only resilient to COVID-19 threat, but also resilient towards sustainability. Three objectives are outlined in this paper to achieve this aim. The first objective is to identify IEQ parameters for office building. The second objective is to analyse the important IEQ parameters that relate to the existing COVID-19 management guideline for office building, and last but not least, the third objective is to develop a sustainable COVID-19 framework for office building.

LITERATURE REVIEW

Coronavirus Disease 2019 (COVID-19)

Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) is commonly known as COVID-19 where this virus is genetically related to SARS-CoV. Recently, COVID-19 has encountered globally and has been intensively discussed (Morawska & Cao, 2020). In accordance with that, there are various research focuses on the COVID-19 (Amoatey et al., 2020; Mehmood et al., 2020; Simon, 2020). The mode of COVID-19 transmission is also discovered where it transmitted through the air which caused by the dissemination of aerosols during sneezing or coughing (Klompas, 2022; Karia et al., 2020; Wilson et al., 2020).

In addition, WHO (2020) acknowledged that COVID-19 transmission could be transmitted in different sizes either as a droplet particle which more than 5 microns diameter, or as droplet nuclei which is less than 5 microns diameter depends on its environment and distance of infected persons. The first COVID19 case in Malaysia

was reported at the beginning of February 2020 where the person had a travel history to Singapore for an International Conference (Lodz et al., 2020).

According to Ministry of Health (MOH) Malaysia website, as of 3rd January 2021, Malaysia recorded a total of 119,077 cases from local and export cases, and 0.4% from total cases is reported to death. In addition, the worldwide cases reported for death is 2.2% from the total of 85,056,808 cases (Worldometer, 2020). It shows that the COVID-19 is a highly portable and deadly infectious disease (Gorbalenya et al., 2020), and the disease has declared as a pandemic by World Health Organization (WHO) in 2021.

This scenario eventually forced the government to enforce lockdown. Countries including Denmark, Italy, Spain Germany, China, and Europe have relied on drastic measures such as social distancing, hygiene measures, and lockdown activities to slow down the COVID-19 transmission (Petersen et al., 2020). In Malaysia, the Movement Control Order (MCO) has enforced by the government during COVID-19 outbreaks to break the transmissions. Since workplace clusters contributed 30% of Malaysia's COVID-19 cases in 2020 (The Edge Markets, 2020), this MCO enforcement has imposed lockdown orders, restricted the day-to-day activities and outdoor movement, and also closed down all non-essential business activities.

Besides, workplace clusters have emerged as a key source of COVID-19 infection in Malaysia, with hundreds of cases traced to private companies and government agencies (New Straits Times, 2021). This eventually created the highest unemployment rate in 2020 which reported at 5.3% (Department of Statistics Malaysia, 2020) and eventually triggered people's job and income.

Considering the situation of isolation resulted from the COVID-19 pandemic, employees are facing mental health problems where the anxiety and stress levels are worsening (Mercer, 2020). Furthermore, the feelings of distress, fatalism, and frustration could lead to increase blood pressure (O'Neil et al., 2020), or eventually mental worsening (Godinic et al., 2020) from isolation activities. In terms of financial matter, an additional of 2.2 million people may end up into poverty in the emerging and developing countries at the end of 2020 during COVID-19 pandemic (World Bank Group, 2020).

COVID-19 STANDARD OPERATING PROCEDURE (SOP)

In this current state, the solution of control the transmission of COVID-19 has been implemented especially within the behavioural control (Pinheiro & Luis, 2020). Most countries are currently trying to prevent the spread of COVID-19 by implementing the social distancing policies with an emphasis on the human being's health (Mofijur et al., 2021). Besides, recent researchers claimed that by closing the country boundaries could control the initial spread of COVID-19 (Chinazzi et al., 2020; Aldila et al., 2020; Beck & Hensher, 2020; Bruine de Bruin et al., 2020; de

Haas et al., 2020). In addition, researcher believes that by isolating at home could control the infection disease (de Haas et al., 2020).

In workplace, researcher from past pandemics believe that measurement control related to physical distancing, avoiding public meetings, isolating the diseased, and wearing face mask are the most successful measures to slow down the spread of pandemics (Peeri et al., 2020). According to Cirrincione et al. (2020), COVID-19 guideline is expected to be part of the 'new norms' for office, not only in the period of the pandemic, but possibly as practices that will continue to operate for long term period as precautionary measures for future disease outbreaks.

In Malaysia, COVID-19 SOP has enforced during the pandemic to minimize the transmission of COVID-19 viruses among communities such as practicing social distancing, avoiding crowded places, wearing face mask or face shield and so forth (MOH, 2020). As stated by Akyar (2012), SOP would provide a step-by-step document process which describes in detail the way that an entity should perform a given operation. Therefore, MOH Malaysia has outlined the COVID-19 SOP in workplace, as below.

Table 1: COVID-19 Standard Operating Procedure in Workplace

No.	COVID-19 Standard Operating Procedure
1.	Wear face mask or face shield
2.	Frequent hand washing/hand sanitizer
3.	Practice personal hygiene and respiratory etiquette
4.	Limit food handling and food sharing
5.	Regular cleaning and disinfection surface
6.	Avoid handshaking
7.	Using alternate communication methods such as virtual platform
8.	Practising physical distancing
9.	Avoiding public spaces, gatherings, and crowds
10.	Avoiding contact with people who could be high-risk
11.	Avoiding meeting in a large-scale size
12.	Taking temperature or thermal screening
13.	Registering contact details to ease contact tracing
14.	Consider opening windows for natural lighting and better ventilation
15.	Avoid touching eyes, nose, and mouth
16.	Relieve/Stay home if get sick/ feel unwell
17.	Avoid travelling who are in high-risk
18.	Self-isolate (14 days) who has recently visited latest COVID-19 hotspots
19.	Encourage work from home whenever possible
20.	Self-declaration on travel

Source: MOH Malaysia – Annex 25 (2020)

However, since most of the COVID-19 transmission occurs indoors environment (Nishiura et al., 2020), Morawska et al. (2020) believed that engineering controls such as increase ventilation rates, supply ventilations with portable air cleaners which is the mechanical filtration systems, and so forth in combinations with other controls such as isolation or quarantine, and social distancing could minimize the COVID-19 transmissions.

GREEN BUILDING

Green building was established in the reasons of reducing greenhouse gas emission and energy consumption significantly. It tends to practice of increasing building efficiency, reduce building impact on human health and environment, better sitting, design, construction, operation, maintenance and removal of building, and resource efficient and environmentally responsible (Urban land Institute, 2005). Besides, green building focuses on increasing the efficiency of resource use energy, water and materials while reducing building impact on human health and environment during the life cycle of the building (US Green Building Council, 2010).

Ohueri et al. (2018) claimed that several offices are adopting green building concept due to the need for resource efficiency and improved employees' output. By adopting green office building, it indirectly provides the triple-bottom line benefits of sustainable development which is environmental, economic, and social aspects (Nilashi et al., 2015). The air and water quality advancement, waste reduction, and natural resource conservation are some of the benefits of environmental aspects (CIDB, 2016). In terms of possible economic benefits, researchers believe that it includes the benefit of reduction of energy cost (Vanek & Vogel, 2007), and life cycle economic performance optimisation (Ahn, 2010). Moreover, Kaushik et al. (2020) perceived social benefits in terms of the productivity of occupants in office buildings.

INDOOR ENVIRONMENTAL QUALITY (IEQ)

Indoor Environmental Quality (IEQ) is one of key criteria in Green Building Index (GBI) assessment rating tool to meet the concept of green building towards sustainable development. As described by Omer (2008), IEQ is the perceived condition of comfort that occupants experienced physically and psychologically from their surroundings. It acts as evaluation as one of the aspects of green building rating criteria which not only focused on achieving a healthy environment for occupants, but also to environment that promotes health and productivity of the occupants. This could be supported from previous study which IEQ could has significant impact to occupants' comfort, productivity, and health in office buildings (Fisk, 2002; Collinge et al., 2014; Esfandiari et al., 2017; Kaushik et al., 2020).

Clements-Croome & Kaluarachchi (1998) emphasised that IEQ encompasses a range of environmental conditions including temperature, humidity, indoor air quality (IAQ), lighting, ventilation, noise, and crowdedness of workspace. Besides, Ravindu et al. (2015) claimed that thermal condition quality, indoor air quality, lighting quality, and acoustic quality is the parameter of IEQ. Therefore, by referring to GBI assessment criteria (2011) for nonresidential building, IEQ consists of four main assessment area and fifteen parameters involved that should be considered in assessing IEQ of a building to be recognised as a green, as below.

Table 2: Indoor Environmental Quality Elements for Non-Residential Building

Criteria	Assessment Area	Parameter
Indoor Environmental Quality	Air Quality	EQ1 Minimum IAQ Performance
		EQ2 Environmental Tobacco Smoke (ETS) Control
		EQ3 Carbon Dioxide Monitoring and Control
		EQ4 Indoor Air Pollutants
		EQ5 Mould Prevention
	Thermal Comfort	EQ6 Thermal Comfort: Controllability of Systems
		EQ7 Air Change Effectiveness
	Lighting, Visual & Acoustic Comfort	EQ8 Daylighting
		EQ9 Daylight Glare Control
		EQ10 Electric Lighting Levels
		EQ11 High Frequency Ballasts
		EQ12 External Views
		EQ13 Internal Noise Levels
		EQ14 IAQ Before/During Occupancy
	Verification	EQ15 Occupancy Comfort Survey: Verification

Source: GBI (2011)

METHODOLOGY STUDY AREA

This study mainly focuses on the green office building within the centre of Johor Bahru district which is Menara Majlis Bandaraya Johor Bahru (MBJB). A 15storey office building of Menara Majlis Bandaraya Johor Bahru that located at Bukit Senyum, Johor Bahru was completed in the year of 2019 and was certified by Green Building Index (GBI), Malaysia. Menara MBJB is chosen because of the location is located in the high population density where many office buildings is available in the centre of the city. In this study, questionnaire regarding the advancement of COVID-19 SOP for office building is focused.

DATA COLLECTION

Data are collected through two parts which is primary data and secondary data. Primary data comprises set of questionnaires which involved of the COVID-19 SOP and IEQ parameters that have been prepared to be distributed to employees who is working in the study area. Likert-scale is used in the questionnaire in order to determine the degree of importance level to express the perception of respondents. Five-degree level of importance is used which are 'Not Very Important', 'Not Important', 'Neutral', Important', 'Very Important'.

Meanwhile, the secondary data is gathered from literature review in various form such as journals, articles, thesis, conference papers, and related references book. Literature review is assessed regarding COVID-19 disease, SOP, green building, and IEQ. However, to identify the IEQ parameters and existing COVID-19 guidelines, the GBI assessment criteria for non-residential building and COVID-19 SOP for workplace enforced by MOH is obtained, respectively.

RESPONDENT SAMPLING

There are two types of sampling which are the probability sampling and nonprobability sampling. The probability sampling method for this study is used. As mentioned by Creswell (2012), individual is being selected to present the population of the groups. Therefore, to determine the advancement of COVID19 SOP in workplace, this study adopted probability sampling which is random sampling.

The targeted respondent for this study is employee who works in Menara MBJB. Therefore, the respondent of this study is assumed to have 1391 in population size which indicate the total number of employees in Menara MBJB. Therefore, the sample of this study is calculated by using Taro Yamane (Yamane, 1973) formula with 95% confidence level. The calculation formula of Taro Yamane is presented as follows:

$$n = \frac{N}{1 + N\,(e)_2}$$

where,

n = Sample size required
N = Number of people in the population
e = Sampling error (%)

By substituting numbers into this formula,

$$n = \frac{1391}{1 + 1391\ (0.1)_2}$$
$$= \mathbf{93}$$

After calculated the sample size by using the formula from Taro Yamane, the numbers of sample are 93 respondents. Therefore, sample size of this study confidence levels at 95% and error is ±10% due to the difficulties in collect data during pandemic era. From this research, there are 93 data of respondents is collected.

DATA ANALYSIS

There are some methods adopted to present and analysis of the data to achieve the research objectives. In this study, content analysis is used to achieve the first objective which is to identify IEQ parameters for office building. As for the expected finding for first objective, the list of IEQ parameters for office building is obtained. Besides, COVID-19 SOP issued by MOH is also obtained using content analysis method. Subsequently, literature review that has been analysed using content analysis is used to achieve the second objectives which is to analyse the important IEQ parameters that relate to the existing COVID-19 management guideline for office building. Questionnaire is then evaluated using frequency analysis to discover the important COVID-19 SOP and IEQ parameters based on employee perspectives.

In this study, frequency analysis is adopted in order to analysis the questionnaires collected from the survey. The results of frequency analysis have a percentage the highest indicates that the majority of respondents chose the preference as their priority in this study (Ahmad, 2010). Apart from that, an index is required to determine the position or degree of importance of each the importance level that has been analysed. On the other hand, the index range is obtained, and the position or degree of each importance level is determined. Therefore, this analysis is expected to gather the important existing COVID-19 guideline and IEQ parameters based on employee perspectives.

As for third objective which is to develop a sustainable COVID-19 framework for office building, the data is analysed using Cross Tabulation analysis. The highest degree of importance level will be adopted in developing sustainable COVID-19 framework for office building.

RESULT AND DISCUSSIONS IMPORTANT EXISTING COVID-19 GUIDELINE AND IEQ PARAMETER

To analyse important IEQ parameter that relate to the existing COVID-19 management guideline for office building, frequency analysis is conducted to analyse the findings.

Table 3: Mean Value and Ranking of COVID-19 SOP

COVID-19 Standard Operating Procedure	SD	Mean	Rank
Avoid contact with people who could be high-risk	**0398**		**1**
Wear face mask/face shield	**0.673**	**4.78**	**2**
Frequent hand washing/hand sanitizer	**0.439**		**3**
Relieve/Stay home if get sick/ feel unwell	**0.463**	**4.78**	**4**
Avoid public spaces, gatherings, and crowds	0.469		**5**
Avoid meeting in a large-scale size	0.469		**6**
Practice personal hygiene and respiratory etiquette	0.497		7
Avoid travelling who are in high-risk	0.523		**8**
Self-isolate (14days) who has recently visited latest	0.502	4.71	9
COVID-19 hotspots			
Practice physical distancing	0.527		10
Avoid handshaking	0.619		11
Register contact details to ease contact tracing	0.530		12
Encourage work from home whenever possible	0.641		13
Self-declaration on travel	0.569	4.62	14
Perform alternate communication methods such as virtual	0.592		15
Regular cleaning and disinfection surface	0.612		16
Limit food handling and food sharing	0.712		17
Temperature or thermal screening	0.716		18
Avoid touching eyes, nose, and mouth	0.699		19
Consider opening windows for natural lighting and better ventilation	0.766	4.31	20

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As a result, by looking into their mean value, it presents that the highest ranked for COVID-19 SOP is avoiding contact with people who could be high-risk which the mean value is 4.84. It is followed by the SOP of wearing face mask or face shield, frequent hand washing or use hand sanitiser, as well as relieve or stay home if get sick or feel unwell where their mean value is the same which are

4.78. Considering opening windows for natural lighting and better ventilation also ranked the least important to prevent the spread of COVID-19 where their mean value is 4.31. However, in order to identify the importance level based on their ranking, rescale is conducted using the index range formula as in Table 5 and Table 6 below.

Table 4: Mean Value and Ranking for IEQ Parameter

Indoor Environmental Quality Parameter	SD	Mean	Rank
EQ2 Environmental Tobacco Smoke (ETS) Control	0.469	4.77	1
EQ7 Air Change Effectiveness	0.440	4.74	2
EQ1 Minimum IAQ Performance	0.588	4.62	3
EQ5 Mould Prevention	0.599	4.55	4
EQ3 Carbon Dioxide Monitoring and Control	0.653	4.53	5
EQ8 Daylighting	0.619	4.51	6
EQ6 Thermal Comfort: Controllability of Systems	0.619	4.49	7
EQ14 IAQ Before/During Occupancy	0.648	4.42	8
EQ15 Occupancy Comfort Survey: Verification	0.679	4.41	9
EQ10 Electric Lighting Levels	0.678	4.40	10
EQ4 Indoor Air Pollutants	0.765	4.38	11
EQ12 External Views	0.659	4.31	12
EQ9 Daylight Glare Control	0.786	4.24	13
EQ13 Internal Noise Levels	0.832	4.22	14
EQ11 High Frequency Ballasts	0.822	4.10	15

As result for the IEQ parameter, it presents that the highest ranked for IEQ parameters is the EQ2 Environmental Tobacco Smoke (ETS) Control which the mean value is 4.77. It is followed by the IEQ parameters of EQ7 Air Change Effectiveness and EQ1 Minimum IAQ Performance where their mean value is 4.74 and 4.62, respectively. As mentioned before, EQ11 High Frequency Ballasts shows the least important parameter for office buildings. From this ranking, EQ11 High Frequency Ballasts also shows the least important parameter where their mean value is 4.10. However, in order to identify the importance level based on their ranking, rescale is conducted using index range formula as below.

Table 5: Index Range for COVID-19 SOP

Category of Scale	Range of Mean Value
Very Important	4.74 – 4.84
Important	4.63 – 4.73
Neutral	4.53 – 4.62
Not Important	4.42 – 4.52
Very Not Important	4.31 – 4.41

The maximum and minimum mean values for the COVID-19 SOP are 4.84 and 4.31, respectively. Therefore, the index range for COVID-19 SOP is 0.106. This indicates that there are 20 COVID-19 SOP in this study, with mean value between 4.31 to 4.84. From this, this shows that the important COVID-19 SOP in workplace is between the mean value of 4.63 to 4.84 and will be selected to develop a sustainable COVID-19 framework as an advancement for existing COVID-19 SOP. However, the mean value between 4.31 to 4.62 indicates that this range of COVID-19 SOP is not important to improve the current COVID-19 SOP in workplace.

Table 6: Index Range for IEQ Parameter

Category of Scale	Range of Mean Value
Very Important	4.65 – 4.77
Important	4.52 – 4.64
Neutral	4.38 – 4.51
Not Important	4.23 – 4.37
Very Not Important	4.10 – 4.22

As for the index range for IEQ parameter, the maximum and minimum mean values for the IEQ parameter are 4.77 and 4.10, respectively. Therefore, the index range for IEQ parameter is 0.134. This indicates that there are 15 IEQ parameters in this study, with mean value between 4.10 to 4.77. From this, this shows that the important IEQ parameter is between the mean value of 4.52 to 4.77 and will be selected to develop a sustainable COVID-19 framework as an advancement for existing COVID-19 SOP. However, the mean value between 4.10 to 4.51 indicates that this range of IEQ parameter is not important to integrate with COVID-19 SOP in order to improve the current COVID-19 SOP in workplace.

From the result above, Table 7 and Table 8 below presents the overall rescale for COVID-19 SOP and IEQ parameter according to their mean value, respectively.

Table 7: Rescale for COVID-19 SOP According to Mean Value

COVID-19 Standard Operating Procedure	Mean	Scale
Avoid contact with people who could be high-risk	4.84	Very Important
Wear face mask/face shield	4.78	Very Important
Frequent hand washing/hand sanitizer	4.78	Very Important
Relieve/Stay home if get sick/ feel unwell	4.78	Very Important
Avoid public spaces, gatherings, and crowds	4.73	Important
Avoid meeting in a large-scale size	4.73	Important
Practice personal hygiene and respiratory etiquette	4.72	Important
Avoid travelling who are in high-risk	4.71	Important
Self-isolate (14days) who has recently visited latest COVID-19 hotspots	4.71	Important
Practice physical distancing	4.70	Important
Avoid handshaking	4.65	Important
Register contact details to ease contact tracing	4.62	Neutral
Encourage work from home whenever possible	4.62	Neutral
Self-declaration on travel	4.62	Neutral
Perform alternate communication methods such as virtual platform	4.60	Neutral
Regular cleaning and disinfection surface	4.59	Neutral
Limit food handling and food sharing	4.58	Neutral
Temperature or thermal screening	4.47	Not Important
Avoid touching eyes, nose, and mouth	4.44	Not Important
Consider opening windows for natural lighting and better ventilation	4.31	Very Not Important

Table 7 presents the rescale for the COVID-19 SOP according to their range of mean value. By referring to COVID-19 SOP range of mean value for 'Very Important' which is 4.74 to 4.84, avoiding contact with people who could be high-risk, wear face mask/face shield, frequent hand washing/hand sanitizer, and relieve/Stay home if get sick/ feel unwell are located under 'Very Important' level since their mean value is in between the range of 4.74 to 4.84. Apart from that, avoid public spaces, gatherings, and crowds, avoid meeting in a large-scale size, practice personal hygiene and respiratory etiquette, avoid travelling who are in high-risk, self-isolate (14 days) who has recently visited latest COVID-19 hotspots, practice physical distancing, and avoid handshaking is recorded under 'Important' level according to their range of mean value which is in between 4.63 to 4.73. From this, the 'Very Important' and 'Important COVID-19 SOP will be selected to develop sustainable COVID-19 framework.

The COVID-19 SOP of registering contact details to ease contact tracing, encourage work from home whenever possible, self-declaration on travel, perform alternate communication methods such as virtual platform, regular cleaning and disinfection surface, and limit food handling and food sharing are recorded in between the range of 4.53 to 4.62 where it indicates their importance level of 'Neutral'. Followed by the 'Not Important' level which are temperature or thermal screening and avoid touching eyes, nose, and mouth, their range mean value is recorded in between 4.42 to 4.52. Last but not least, as for "Very Not Important' level which is considering opening windows for natural lighting and better ventilation, it is recorded in between the range of 4.31 to 4.41. From this, the "Neutral', 'Not Important', and 'Very Not Important' level are not important COVID-19 SOP as they are ranked below than mean value of 4.63.

Table 8: Rescale for IEQ Parameter According to Mean Value

Indoor Environmental Quality Parameter	**Mean**	**Scale**
EQ2 Environmental Tobacco Smoke (ETS) Control	4.77	Very Important
EQ7 Air Change Effectiveness	4.74	Very Important
EQ1 Minimum IAQ Performance	4.62	Important
EQ5 Mould Prevention	4.55	Important
EQ3 Carbon Dioxide Monitoring and Control	4.53	Important
EQ8 Daylighting	4.51	Neutral
EQ6 Thermal Comfort: Controllability of Systems	4.49	Neutral
EQ14 IAQ Before/During Occupancy	4.42	Neutral
EQ15 Occupancy Comfort Survey: Verification	4.41	Neutral
EQ10 Electric Lighting Levels	4.40	Neutral
EQ4 Indoor Air Pollutants	4.38	Neutral
EQ12 External Views	4.31	Not Important
EQ9 Daylight Glare Control	4.24	Not Important
EQ13 Internal Noise Levels	4.22	Very Not Important
EQ11 High Frequency Ballasts	4.10	Very Not Important

Table 8 presents the rescale for the IEQ parameters according to their range of mean value. By referring to IEQ parameters range of mean value for 'Very Important' which is 4.65 to 4.77, EQ2 Environmental Tobacco Smoke (ETS) Control and EQ7 Air Change Effectiveness are located under 'Very Important' level since their mean value is in between the range of 4.65 to 4.77. Apart from that, EQ1 Minimum IAQ Performance, EQ5 Mould Prevention, and EQ3 Carbon Dioxide Monitoring and Control is recorded under 'Important' level

according to their range of mean value which is in between 4.52 to 4.64. From this, the 'Very Important' and 'Important IEQ parameters will be selected to integrate with COVID-19 SOP in order to improve the current COVID-19 SOP for workplace.

The IEQ parameters of EQ8 Daylighting, EQ6 Thermal Comfort: Controllability of Systems, EQ14 IAQ Before/During Occupancy, EQ15 Occupancy Comfort Survey: Verification, EQ10 Electric Lighting Levels, EQ4 Indoor Air Pollutants are in between the range of 4.38 to 4.51 where it indicates their importance level of 'Neutral'. Followed by the 'Not Important' level which are EQ12 External Views and EQ9 Daylight Glare Control, their range mean value is in between 4.23 to 4.37. Last but not least, as for "Very Not Important' level which are EQ13 Internal Noise Levels and EQ11 High Frequency Ballasts, they are recorded in between the range of 4.10 to 4.22. From this, the "Neutral', 'Not Important', and 'Very Not Important' level are not important IEQ parameters as they are ranked below than mean value of 4.52.

SUSTAINABLE COVID-19 FRAMEWORK FOR OFFICE BUILDING

As for the third objective which is to develop sustainable COVID-19 framework for office building, the Cross Tabulation analysis is conducted regarding the important COVID-19 SOP and IEQ parameters based on the findings from second objective which is to analyse the important IEQ parameters that relate to the existing COVID-19 management guideline for office building.

As for the main purpose, important COVID-19 SOP and important IEQ parameters is selected to construct the cross-tabulation analysis in order to observe the main IEQ parameters that relate to the context of COVID-19 SOP in workplace. Thus, this analysis is conducted to examine the relationship between these two variables based on employee perspectives.

The data from respondents has been verified through the index range scale. Table 9 below presents the COVID-19 SOP and IEQ parameters are chosen based on the level of 'Important' and 'Very Important' which the range of mean value are in between 4.63 to 4.84 for COVID-19 Standard SOP and 4.52 to 4.77 for IEQ parameters. From this analysis, the data presents the total number of respondents that have chosen the 'Very Important' and 'Important' level between these two variables to access the IEQ parameters that can assist in improving the COVID-19 SOP. Most of the COVID-19 SOP and IEQ parameters that being clustered in the index range scale has higher respond from the employees.

Table 9: Cross Tabulation Between Important COVID-19 SOP and Important IEQ

IEQ PARAMETER / COVID19 SOP	**EQ1 Minimum IAQ Performance**	**EQ2 Environmental Tobacco Smoke (ETS)**	**EQ3 Carbon Dioxide Monitoring**	**EQ5 Mould Prevention**	**EQ7 Air Change Effectiveness**
Wear face mask or face shield	87	88	85	85	90
Frequent hand washing/hand sanitizer	89	90	86	87	92
Practice personal hygiene and respiratory etiquette	88	89	85	86	91
Avoid handshaking	84	85	81	82	86
Practice social or physical distancing	88	88	85	85	90
Avoid public spaces, gatherings, and crowds	89	90	86	87	92
Avoid contact with people who could be high-risk	89	90	86	87	92
Avoid meeting in a large-scale size	89	90	86	87	92
Relieve/Stay home if get sick/ feel unwell	88	89	85	87	91
Avoid travelling who are in highrisk	87	88	85	85	90
Self-isolate (14 days) who has recently visited latest COVID-19 hotspots	88	89	85	87	91

Based on the results, most of employee has the same option in rating the importance level of COVID-19 SOP and IEQ parameters. In other words, most of employees believe that IEQ parameters of EQ7 Air Change Effectiveness can be integrated with COVID-19 SOP to develop sustainable COVID-19 framework for office building in order to improve the existing COVID-19 management guideline in workplace. Therefore, a sustainable COVID-19

framework for office building is developed referring to the existing COVID-19 guidelines with green element which is EQ7 Air Change Effectiveness.

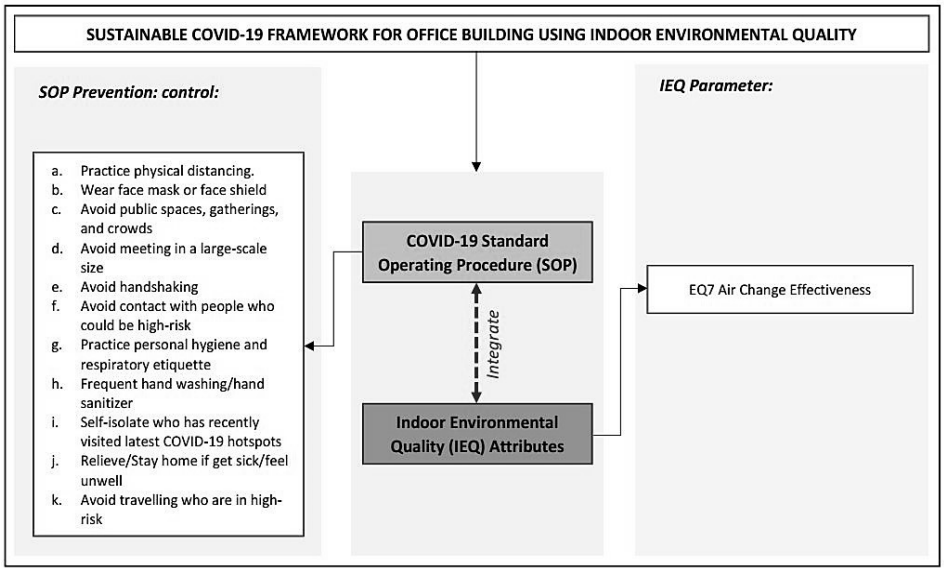

Figure 1: Sustainable COVID-19 Framework for Office Building

Since WHO acknowledge the transmission of COVID-19 virus is through airborne, thus, this result is relatable in providing the suitable COVID19 framework for office building to prevent the spread of COVID-19 whereby providing an effective clean air delivery could limit the spread of viruses since people are spend their time mostly indoors. This finding aligned with Rendana (2020). Therefore, in the context of COVID-19, EQ7 Air Change Effectiveness is the most important parameters that can be integrated with COVID-19 SOP in workplace. From this, the building manager or COVID-19 management team could use this finding as a reference or guidance in order to prevent or reduce the spread of COVID-19 in workplace from getting worst.

Nevertheless, the result from cross tabulation analysis is contributed to the outcome of this study in order to develop a sustainable COVID-19 framework for office building which not only resilient to COVID-19, but also resilient to sustainability. The data is chosen based on higher results from cross tabulation analysis between COVID-19 SOP and IEQ parameters. Therefore, the developed framework of the most highly important of IEQ parameters that can be contributed in COVID-19 SOP advancement.

CONCLUSIONS

There are eleven important COVID-19 SOP to prevent the spread of COVID-19 based on employee perspectives which are avoiding contact with people who could be high-risk, wear face mask/face shield, frequent hand washing/hand sanitizer, relieve/stay home if get sick/feel unwell, avoid public spaces, gatherings, and crowds, avoid meeting in a large-scale size, practice personal hygiene and respiratory etiquette, avoid travelling who are in high-risk, selfisolate (14days) who has recently visited latest COVID-19 hotspots, practice physical distancing, and avoid handshaking.

Meanwhile, there are five important IEQ parameters based on employee perspectives which are EQ2 Environmental Tobacco Smoke (ETS) Control, EQ7 Air Change Effectiveness, EQ1 Minimum IAQ Performance, EQ5 Mould Prevention, and EQ3 Carbon Dioxide Monitoring and Control. However, EQ7 Air Change Effectiveness presents the most important IEQ parameters that relate to the context of COVID-19 SOP to prevent COVID-19 spread.

Those results obtained could be beneficial as it could be used as guidance for COVID-19 management team in workplace in order to improve the COVID19 SOP in workplace to prevent the spread of COVID-19. By identifying and producing a framework of sustainable COVID-19 framework for office building, the building manager or COVID-19 management team in workplace is encouraged to set up a sustainable COVID-19 framework as an advancement for existing COVID-19 guideline by integrating with IEQ. However, this framework is not only resilient to COVID-19, but also resilient to sustainability and can be used as future reference in context of sustainability.

REFERENCES

Ahn, Y.H. (2010). The development of models to identify relationships between first costs of green building strategies and technologies and life cycle costs for public green facilities. Virginia Polytechnic Institute and State University, Blacksburg, VA.

Akyar, I. (2012). Standard operating procedures (what are they good for?). Latest Research into Quality Control. https://doi.org/10.5772/50439

Aldila, D., Khoshnaw, S. H., Safitri, E., Anwar, Y. R., Bakry, A. R., Samiadji, B. M., & Salim, S. N. (2020). A mathematical study on the spread of COVID-19 considering social distancing and rapid assessment: The case of Jakarta, Indonesia. Chaos, Solitons & Fractals, 139, 110042.

Amoatey, P., Omidvarborna, H., Baawain, M. S., & Al-Mamun, A. (2020). Impact of building ventilation systems and habitual indoor incense burning on SARS-CoV-2 virus transmissions in Middle Eastern countries. *Science of the Total Environment*, 733, 139356.

Annex 25 COVID-19: Management guidelines for workplaces. (2020). Ministry of Health. Malaysia. http://covid-19.moh.gov.my/garis-panduan/garispanduan-kkm/Annex_25_COVID_guide_for_workplaces_22032020.pdf

Bashir, M. F., Ma, B., Bilal, Komal, B., Bashir, M. A., Tan, D., & Bashir, M. (2020). Correlation between climate indicators and COVID-19 pandemic in New York, USA. *Science of The Total Environment*, 728, 138835. https://doi.org/10.1016/j.scitotenv.2020.138835

Beck, M. J., & Hensher, D. A. (2020). Insights into the impact of COVID-19 on household travel and activities in Australia–The early days of easing restrictions. *Transport policy*, 99, 95-119.

Bogoch, I. I., Watts, A., Thomas-Bachli, A., Huber, C., Kraemer, M. U., Khan, K. (2020) Pneumonia of unknown etiology in Wuhan, China: Potential for International Spread Via Commercial Air Travel. J Trav Med 27. https://doi.org/10.1093/jtm/taaa008

Bruine de Bruin, W. (2020). Age differences in COVID-19 risk perceptions and mental health: Evidence from a national US survey conducted in March 2020. *The Journals of Gerontology*: Series B.

Chan, K. H., Peiris, J. S., Malik, Lam, S. Y., Poon, L. L. M., Yuen, K. Y., Seto, W. H. (2011). The Effects of Temperature and Relative Humidity on the Viability of the SARS Coronavirus. *Advances in Virology*, 2011(), 1–7. doi:10.1155/2011/734690

Chinazzi, M., Davis, J. T., Ajelli, M., Gioannini, C., Litvinova, M., Merler, S., ... & Viboud, C. (2020). The effect of travel restrictions on the spread of the 2019 novel coronavirus (COVID-19) outbreak. *Science*, 368(6489), 395400.

CIDB. (2016). Available at: <https://www.cidb.gov.my/sites/default/files/202003/CIDB-Annual-Report-2016-new.pdf> [Accessed 25 March 2021].

Cirrincione, L., Plescia, F., Ledda, C., Rapisarda, V., Martorana, D., Moldovan, R. E., Theodoridou, K., & Cannizzaro, E. (2020). COVID-19 pandemic: Prevention and protection measures to be adopted at the workplace. *Sustainability, 12*(9), 3603–. doi:10.3390/su12093603

Clements-Croome D. & Kaluarachchi Y. An Assessment of the Influence of the Indoor Environmental on the Productivity of Occupants in Offices in Moschandreas J. D. (1998) Design, Construction, and Operation of Healthy Buildings: Solutions to Global and Regional Concerns. USA: ASHRAE

Collinge, W. O., Landis, A. E., Jones, A. K., Schaefer, L. A., & Bilec, M. M. (2014). Productivity metrics in dynamic LCA for whole buildings: Using a post-occupancy evaluation of energy and indoor environmental quality trade-offs. *Building and Environment*, 82, 339-348.

de Haas, M., Faber, R., & Hamersma, M. (2020). How COVID-19 and the Dutch 'intelligent lockdown'change activities, work and travel behaviour:

Evidence from longitudinal data in the Netherlands. Transportation Research Interdisciplinary Perspectives, 100150.

Department of Statistics Malaysia Official Portal. (2022). Dosm.gov.my. https://www.dosm.gov.my/v1/index.php?r=column/cthemeByCat&cat=124&bul_id=L2NnM0h0bFc2SGFaRGZEeGxETCtuZz09&menu_id=U3VPMldoYUxzVzFaYmNkWXZteGduZz09

Dietz, L., Horve, P. F., Coil, D. A., Fretz, M., Eisen, J. A., & Van Den Wymelenberg, K. (2020). 2019 novel coronavirus (COVID-19) pandemic: built environment considerations to reduce transmission. *Msystems*, 5(2), e00245-20.

Esfandiari, M., Zaid, S., Ismail, M., & Aflaki, A. (2017). Influence of Indoor Environmental Quality on Work Productivity in Green Office Buildings: A Review. Chemical Engineering Transactions. 56. 10.3303/CET1756065.

Fisk W.J. (2002). How IEQ affects health and productivity, ASHRAE journal, 44. GBI Assessment Criteria for Non-residential Existing Building. (2011). https://www.greenbuildingindex.org/Files/Resources/GBI%20Tools/GBI%20NREB%20Non-

Residential%20Existing%20Building%20Tool%20V1.1%20Final.pdf Godinić, D., & Obrenovic, B. (2020). Effects of economic uncertainty on mental health in the COVID-19 pandemic context: social identity disturbance, job uncertainty and psychological well-being model. *International Journal of Innovation and Economic Development, 6*(1).

Gorbalenya, A., Baker, S., Baric, R., Groot, R., Drosten, C., Gulyaeva, A. (2020). Severe acute respiratory syndrome-related coronavirus: The species and its viruses–a statement of the Coronavirus Study Group. BioRxiv preprint. http://doi.org/10.1101/2020.02.07.937862

Kabir, M. T., Uddin, M. S., Hossain, M. F., Abdulhakim, J. A., Alam, M. A., Ashraf, G. M., Bungau, S. G., Bin-Jumah, M. N., Abdel-Daim, M. M. and Aleya, L. (2020). COVID-19 pandemic: From molecular pathogenesis to potential investigational therapeutics. Frontiers in cell and developmental biology, 8.

Karia, R., Gupta, I., Khandait, H., Yadav, A., & Yadav, A. (2020). COVID-19 and its Modes of Transmission. *SN comprehensive clinical medicine, 2*(10), 1798–1801. https://doi.org/10.1007/s42399-020-00498-4.

Kaushik, A., Mohammed, Tumula, & Ebohon. (2020). Effect of thermal comfort on occupant productivity in office buildings: Response surface analysis. *Building and Environment.* 180. 107021. 10.1016/j.buildenv.2020.107021.

Klompas, M., Ye, S., Vaidya, V., Ochoa, A., Baker, M. A., Hopcia, K., Hashimoto, D., Wang, R., & Rhee, C. (2022). Association Between Airborne Infection Isolation Room Utilization Rates and Healthcare

Worker Severe Acute Respiratory Syndrome Coronavirus 2 (SARSCoV-2) Infections in 2 Academic Hospitals. Clinical infectious diseases: an official publication of the Infectious Diseases Society of America, 74(12), 2230–2233. https://doi.org/10.1093/cid/ciab849

Lodz, N. A., Chong, Z. L, Hasani, W. S. R., Ahmad, N. A., Ahmad, F. H., Rifin, H. M., Yusof, M. P., et al. (2020). COVID-19 outbreak related to the first workplace cluster in Malaysia. Zenodo. http://doi.org/10.5281/zenodo.4019952

Mehmood, K., Iqbal, M., & Abrar, M. M. (2020). Can exposure to PM2. 5 particles increase the incidence of coronavirus disease 2019 (COVID19)? The Science of the Total Environment, 741, 140441.

Mercer, M. (2020). Turning health risk into value: Are you supporting mental health? Retrieved from

https://www.mercer.com/content/dam/mercer/attachments/global/gl2021-mmb-workforce-health-are-you-supportung-mental-healthfinal.pdf

Mofijur, M., Fattah, I., Alam, M. A., Islam, A., Ong, H. C., Rahman, S., Najafi, G., Ahmed, S. F., Uddin, M. A., & Mahlia, T. (2021). Impact of COVID19 on the social, economic, environmental and energy domains: Lessons learnt from a global pandemic. *Sustainable production and consumption*, 26, 343–359. https://doi.org/10.1016/j.spc.2020.10.016

Morawska, L., & Cao, J. (2020). Airborne transmission of SARS-CoV-2: The world should face the reality. *Environment international*, 139, 105730.

Morawska, L., Tang, J. W., Bahnfleth, W., Bluyssen, P. M., Boerstra, A., Buonanno, G., Cao, J., Dancer, S., Floto, A., Franchimon, F., Haworth,

C., Hogeling, J., Isaxon, C., Jimenez, J. L., Kurnitski, J., Li, Y., Loomans, M., Marks, G., Marr, L. C. Mazzarella, L., Krikor M. A., Miller, S., Milton, D. K., Nazaroff, W., Nielsen, P. V., Noakes, C., Peccia, J., Querol, X., Sekhar, C., SeppÃ¤nen, O., Tanabe, S., Tellier, R., Wai T. K., Wargocki, P., Wierzbicka, A., Yao, M. (2020). How can airborne transmission of COVID-19 indoors be minimised?. *Environment International*, 105832–. doi:10.1016/j.envint.2020.105832

Nilashi, M., Zakaria, R., Ibrahim, O., Abd Majid, M. Z., Mohamad Zin, R., Chughtai, M. W., Abidin, N., Sahamir, S., Dodo, Y. (2015). A knowledge-based expert system for assessing the performance level of green buildings. *Knowledge-Based Systems*. 86. 194-209. 10.1016/j.knosys.2015.06.009.

Nishiura, H., Oshitani, H., Kobayashi, T., Saito, T., Sunagawa, T., Matsui, T. (2020). Closed environments facilitate secondary transmission of coronavirus disease 2019 (COVID-19). medRxiv.

O'Neil, A., Nicholls, S., Redfern, J., Brown, A., Hare, D. (2020). Mental health and psychosocial challenges in the COVID-19 pandemic: Food for thought for cardiovascular health care professionals. *Heart, Lung and Circulation*. 29. 10.1016/j.hlc.2020.05.002.

Ohueri, Chukwuka & Enegbuma, Wallace & Kenley, Russell. (2018). Energy efficiency practices for Malaysian green office building occupants. *Built Environment Project and Asset Management*. 8. 134-146. 10.1108/BEPAM-10-2017-0091.

Omer, A. M. (2008). Energy, environment and sustainable development., 12(9), 2265–2300. doi:10.1016/j.rser.2007.05.001.

Peeri, N. C., Shrestha, N., Rahman, M. S., Zaki, R., Tan, Z., Bibi, S., ... & Haque, U. (2020). The SARS, MERS and novel coronavirus (COVID-19) epidemics, the newest and biggest global health threats: what lessons have we learned?. *International journal of epidemiology*.

Petersen, E., Koopmans, M., Go, U., Hamer, D. H., Petrosillo, N., Castelli, F., Storgaard, M., Al Khalili, S., & Simonsen, L. (2020). Comparing SARSCoV-2 with SARS-CoV and influenza pandemics. *The Lancet. Infectious diseases, 20*(9), e238–e244. https://doi.org/10.1016/S14733099(20)30484-9

Pinheiro, M. D., & Luís, N. C. (2020). COVID-19 Could Leverage a Sustainable Built Environment. Sustainability, 12(14), 5863. https://doi.org/10.3390/su12145863

Ravindu, Sachinthaka & Rameezdeen, Raufdeen & Zuo, Jian & Zhou, Zhihua & Chandratilake, Ravihansa. (2015). Indoor environment quality of green buildings:

Case study of an LEED platinum certified factory in a warm humid tropical climate. *Building and Environment*. 84. 10.1016/j.buildenv.2014.11.001.

Simon, J. A. (2020). Editor's perspective: COVID-19's impact on the remediation industry. Remediation (New York, NY), 30(3), 3.

The Edge Markets. (2020). 30% of Malaysia's Covid-19 clusters linked to the workplace. Retrieved 24 May 2021, from

https://www.theedgemarkets.com/article/30-malaysias-covid19clusters-linked-workplace

U.S. Green Building Council. (2010). USGBC Annual Report 2010. Usgbc.org. https://www.usgbc.org/resources/usgbc-annual-report-2010

Urban Land Institute. (2005). Green office buildings: A practical guide to development.

Vaka, M., Walvekar, R., Rasheed, A. K., & Khalid, M. (2020). A review on Malaysia's solar energy pathway towards carbon-neutral Malaysia beyond Covid'19 pandemic. *Journal of Cleaner Production*, 273, 122834.

Vanek, F., & Vogel, L. (2007). Clean energy for green buildings: an overview of on-and off-site alternatives. *Journal of Green Building, 2*(1), 22-36.

Wilson, Nick; Corbett, Stephen; Tovey, Euan (2020). Airborne transmission of covid-19. BMJ, (), m3206–. doi:10.1136/bmj.m3206

World Health Organizations (WHO). (2020). Transmission of SARS-CoV-2: implications for infection prevention precautions. Who.int; World Health Organization: WHO. https://www.who.int/news-room/commentaries/detail/transmission-of-sars-cov-2-implications-forinfection-prevention-precautions

Zhou, P., Yang, X.L., Wang, X.G., Hu, B., Zhang, L., Zhang, W., Si, H.R., Zhu, Y., Li, B., Huang, C.L. and Chen, H.D. (2020). A pneumonia outbreak associated with a new coronavirus of probable bat origin. nature, 579(7798), 270-273.

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