



UNIVERSITI PUTRA MALAYSIA

***CHEMICAL HEALTH RISK ASSESSMENT OF COMMERCIAL
CHEMICAL DISINFECTANTS FOR HYGIENE PRACTICES AMID
COVID-19 PANDEMIC***

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CHEMICAL DISINFECTANTS FOR HYGIENE PRACTICES AMID
COVID-19 PANDEMIC**



**BY
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NURNAJWA FATINI BINTI ZAMZURI

ABSTRACT

Introduction: Coronavirus disease-2019 (COVID-19), is a novel virus that causes an infectious disease that spreads through recent coronavirus 2 (SARS-CoV-2) originated from Wuhan, China. So far, there are no particular pharmaceutical products that developed to cope with this novel coronavirus. Given this, WHO has suggested fighting from the infecting coronavirus by practicing appropriate preventive measures and a healthy lifestyle. Therefore, chemical disinfectant has widely been adopted since the Covid-19 pandemic as a crucial prevention measure to disinfect the environment and objects through disinfection. **Objective:** This study is to determine the consumers' health risks that arise from the frequent usage of commercial chemical disinfectants for hygiene practices amid the Covid-19 pandemic. **Method:** A total of 50 samples of commercial chemical disinfectants were purchased from an online and physical store during this pandemic. Next, the health hazards information was gathered from samples' labels and Safety Data Sheets. By adopting Manual of Recommended Practice on Assessment of the Health Risks arising from the use of Chemical Hazardous to Health at the Workplace (3rd edition), the health hazard was classified based on ingredients contained in the samples. There are two main routes of exposure which are inhalation and dermal. For inhalation exposure, the level of risk was determined based on Risk Rating (RR), while the risk matrix was used for dermal exposure. **Result:** This study found that, at least 22 samples had moderate inhalation health risk, conversely, 36 samples are reported to have moderate dermal health risks (M2) and 7 samples had high dermal health risks (H1/H2). **Conclusion:** Disinfection is one of the effective methods for combating Covid-19 infection especially on inanimate surfaces. However, frequent and excessive use of these disinfectants may result in harmful effects on the consumers. It is advised that disinfection activity be conducted only when it is necessary and consumers need to take extra precautions when handling these disinfectants.

Keywords: *Commercial chemical disinfectants, health hazard, health risk.*

PENAKSIRAN RISIKO BAHAN KIMIA KEPADA KESIHATAN TERHADAP PEMBASMI KUMAN KIMIA KOMERSIAL UNTUK AMALAN KEBERSIHAN SEMASA PANDEMIK COVID-19

NURNAJWA FATINI BINTI ZAMZURI

ABSTRAK

Pengenalan: Coronavirus-2019 (COVID-19), adalah virus baru yang menyebabkan penyakit berjangkit yang merebak melalui coronavirus 2 (SARS-CoV-2) yang berasal dari Wuhan, China. Sehingga kini, tidak ada produk farmasi tertentu yang dihasilkan untuk mengatasi virus ini. Oleh itu, WHO telah menyarankan agar memerangi coronavirus dengan mengamalkan langkah pencegahan yang sesuai dan gaya hidup yang sihat. Oleh hal yang demikian, disinfektan kimia telah banyak digunakan sejak pandemik Covid-19 sebagai langkah pencegahan penting untuk membasmi kuman persekitaran dan objek melalui pembasmian kuman. **Objektif:** Kajian ini adalah untuk mengetahui risiko kesihatan pengguna yang terhasil daripada penggunaan disinfektan kimia komersial yang kerap sebagai amalan kebersihan semasa pandemik Covid-19. **Kaedah:** Sebanyak 50 sampel disinfektan kimia komersial dibeli dari kedai dalam talian dan fizikal semasa wabak ini. Seterusnya, beberapa maklumat asas berkaitan hazard terhadap kesihatan dikumpulkan dari label sampel dan Helaian Data Keselamatan, *SDS*. Dengan mengadoptasikan Manual Amalan yang Disarankan pada Penilaian Risiko Kesihatan yang timbul dari Penggunaan Bahan Kimia Berbahaya kepada Kesihatan di Tempat Kerja (edisi ke-3), hazard terhadap kesihatan diklasifikasikan berdasarkan bahan-bahan yang terdapat dalam sampel. Terdapat dua laluan pendedahan utama iaitu pernafasan dan penyerapan pada kulit. Untuk pernafasan, tahap risiko ditentukan berdasarkan penilaian risiko (*RR Rating*), manakala matriks risiko (*Risk Matrix*) digunakan untuk penyerapan pada kulit. **Keputusan:** Kajian ini mendapati bahawa, sekurang-kurangnya 22 sampel mempunyai risiko kesihatan pernafasan tahap sederhana, sebaliknya, 36 sampel dilaporkan mempunyai risiko kesihatan kulit sederhana (M2) dan 7 sampel mempunyai risiko kesihatan kulit yang tinggi (H1 / H2). **Kesimpulan:** Pembasmian kuman adalah salah satu kaedah berkesan untuk memerangi jangkitan Covid-19 terutama pada permukaan yang tidak bernyawa. Walau bagaimanapun, penggunaan disinfektan ini secara kerap dan berlebihan boleh mengakibatkan kesan buruk terhadap kesihatan pengguna. Adalah dinasihatkan agar aktiviti pembasmian kuman dilakukan hanya apabila diperlukan dan pengguna perlu mengambil langkah berjaga-jaga ketika mengendalikan disinfektan ini.

Kata kunci: disinfektan kimia komersial, hazard kesihatan, risiko kesihatan.

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ABBREVIATIONS

ARDS	Acute Respiratory Distress Syndrome
CDC	Centre of Disease Control
CHRA	Chemical Health Risk Assessment
CHTH	Chemical Hazardous to Health
CNS	Central Nervous System
COPD	Chronic Obstructive Pulmonary Disorder
DR	Duration Rating
EPA	Environmental Protection Agency
ER	Exposure Rating
FDR	Frequency-Duration Rating
FR	Frequency Rating
HIV	Human Immunodeficiency Virus
HR	Hazard Rating
ICOP	Industrial Codes of Practice
MR	Magnitude Rating
MSDS	Materials Safety Data Sheets
OSH	Occupational Safety & Health
QAC	Quaternary Ammonium Compound
RR	Risk Rating
SDS	Safety Data Sheets
WHO	World Health Organization

CHAPTER 1

INTRODUCTION

1.1 Study Background

Coronavirus disease-2019 (COVID-19), is a novel virus that causes an infectious disease spreads through recent coronavirus 2 (SARS-CoV-2) originated from Wuhan, China (Huang et al., 2020) This virus is spread primarily through respiratory droplets and close contact (Rai et al., 2020). The common symptom of this disease is characterized by dry cough, fever, pneumonia, and body pain. Epidemiological studies showed a high rate of Covid-19 mortality especially among high-risk populations such as older people particularly in males and immunocompromised individuals or those who are having the chronic disease (Li et al., 2020). The World Health Organization (WHO) has declared COVID-19 as a pandemic since March 2020. Until June 25, 2020 there are 9,110,186 confirmed infectious cases with 473,061 deaths recorded across 216 countries (WHO, 2020). So far, there is no particular pharmaceutical products or vaccine that developed to cope with this novel coronavirus. In view of this, WHO has suggested to fight and stay safe from infecting coronavirus by practicing appropriate preventive measures and a healthy lifestyle (WHO, 2020).

Disinfection is a process involving the usage of the chemical agent to remove pathogen microbes that can be found on inanimate objects. (Rai et al., 2020). Therefore, chemical disinfectant has widely been adopted since Covid-19 pandemic as a crucial prevention measure to sanitize the environment and objects through disinfection. Despite its role in minimizing virus transmission and prevent cross-contamination, there are a lot of myths and misconceptions spreading on social media on the proper usage of chemical disinfectants in the public. For instance, past study

suggested that the inappropriate and unsafe use of these disinfectants will cause harmful health effects to consumers (Yari et al., 2020). The health effects could range from acute to chronic conditions which vary from irritation to skin/eye, to drowsiness, dizziness, and might cause nervous system dysfunction, permanent blindness, convulsion, and paralysis (CDC, 2020)

1.2 Problem Statement

Since surface disinfection is one of the methods recommended by the WHO to combat the transmission of the COVID-19 virus (Li et al., 2020), consumers are eager to protect themselves from being infected with the Covid-19 virus with this approach. According to a recent report by The Freedonia Company, the sales of surface disinfectant wipes are expected to jump 17 percent to hit \$470 million from 2019 to 2020 (Schmidt, 2020). On the other hand, Dettol had a 20 times increase in sales recorded in Shopee Official Store. Apart from that, disinfectant sprays, antiseptic fluid, and hand sanitizers also emerging as the best-selling products listed on ShopBack (New Straits Times, 2020).

United Kingdom Poison Centers received 45,550 exposure calls related to cleaners (28,158) and disinfectants (17,392) between January and March 2020, reflecting an average rise of 20.4 percent to 16.4 percent from January to March 2019 (37,822) and January to March 2018 (39,122) (C et al., 2020). Even though chemical disinfectants do not apply directly to the human body, the nature of disinfecting activity causing them to fall under the high risks exposure among the chemical handlers as well as the consumers. Skin contact, in particular, on the disinfected

surface can induce hazardous skin reactions like irritation, inflammation, and burning in severe conditions (Goh et al., 2020).

The example of frequently used compounds in chemical disinfectants includes sodium hypochlorite, hydrogen peroxide, alcohol, and glutaraldehyde. All of these compounds are proven to have been linked with an increase of health risk to consumers when they are used regularly, such as chronic obstructive pulmonary disease (COPD), asthma, and eye irritation) (Rai et al., 2020). For instance, a recent study (Meeker, 2020) showed that frequent exposure to quaternary ammonium compound (quats) and sodium hypochlorite (bleach) contains in the commercial chemical disinfectant has been related to an elevated risk of COPD of between 24% and 32%. They also lead to inadequate indoor air quality that can exacerbate children's asthma. In fact, quats have also found to potentially cause complications in men with fertility (Meeker, 2020).

1.3 Justification of Study

Since the Covid-19 pandemic, WHO has suggested performing disinfection activities as a means to minimize the risk of Covid-19 virus contamination especially in the non-healthcare setting (e.g. home, office, schools, and restaurant) (WHO, 2020). Other recognized institutions, such as the Center of Disease Control (CDC) (CDC, 2020) also advise the consumer to practice routine cleaning using Environmental Protection Agency EPA- registered disinfectants on frequently touched surfaces (e.g. tables, door handles, light switches, handles, desks, toilet, faucets, sinks, and electronics) (CDC, 2020). Therefore, it is important for the consumer must to understand the background of the disinfectants which they are exposed to in their daily routine and the potential health risks that one's likely to poses from short-term and long-term exposure to these chemicals.

In Malaysia, the Guideline for the Registration Surface Disinfectants, 2020 and Regulation on Classification, Labelling and Safety Data Sheets of Hazardous Chemicals, 2013 are readily available in Malaysia, but still many chemical disinfectants found in the market do not comply to this. Thus, this study is important as it investigates the current status of chemical disinfectant in the market and understand its background of chemical health risks. Next, based on the background ingredients of chemical disinfectants, route of exposure, and exposure levels, this study is conducted to provide the baseline of the potential health risk that may arise from the frequent usage of commercial chemical disinfectants. Moreover, these baseline data will be used to communicate the potential health risks arising from the use of chemical disinfectants during the Covid-19 pandemic and recommend further appropriate control measures to reduce the health risks.

1.4 Research Question

- 1) What are the chemical ingredients contained in the commercial chemical disinfectants?
- 2) What is the health hazards of ingredients contained in the commercial chemical disinfectants?
- 3) What are the potential routes of exposure of commercial chemical disinfectants to consumers?
- 4) What is the level of health risks potentially arising from the usage of commercial chemical disinfectants?

1.5 Research Objective

1.5.1 General Objective

To determine the health risk based on the ingredients listed on the commercial chemical disinfectants for hygiene practices amid the Covid-19 pandemic.

1.5.2 Specific Objectives

- 1) To examine the background ingredients of the commercial chemical disinfectants.
- 2) To classify the health hazards of chemical ingredients contained in the commercial chemical disinfectants.
- 3) To assess the possible routes to exposure of commercial chemical disinfectants.
- 4) To determine the level of health risks potentially arising from the usage of commercial chemical disinfectants.

1.6 Research Hypothesis

It is hypothesized that most chemical disinfectant contains levels of chemical health hazards and potential health risks to the consumers considering their route of exposure, and the frequency and duration of usage.

1.7 Conceptual Framework

Figure 1.0 below describes the conceptual background of the research entitled “Chemical Health Risk Assessment of Commercial Chemical Disinfectant for Hygiene Practices amid COVID-19 Pandemic”. The yellow box shows the different types of commercial disinfectants that are widely used at commercial levels as disinfecting measures. (NPIC, 2020). In general, there are seven main types of chemical disinfectants frequently used by consumers which are alcohol-based, peroxide-based,

phenol-based, quaternary ammonium compounds (QACs), chlorine compound, aldehydes, and iodophores (Al-Sayah, 2020)

The independent variable is the health hazard classification based on the chemical ingredients listed on the label of disinfectant used by the consumers. Besides, information such as the route of exposure, magnitude, and degree of exposure was taken into account based on the background data obtained from Safety Data Sheet (SDS) and ICOP. The dependent variable that presented in the blue box is to indicate the potential health risks from exposure to chemical disinfectants. Determination of risk levels was divided into three categories; low risk, moderate risk, and high risk. After determining the risk level, the control measure would be suggested at the end of this study to reduce the potential health risks from exposing to this commercial chemical disinfectant among the consumers.

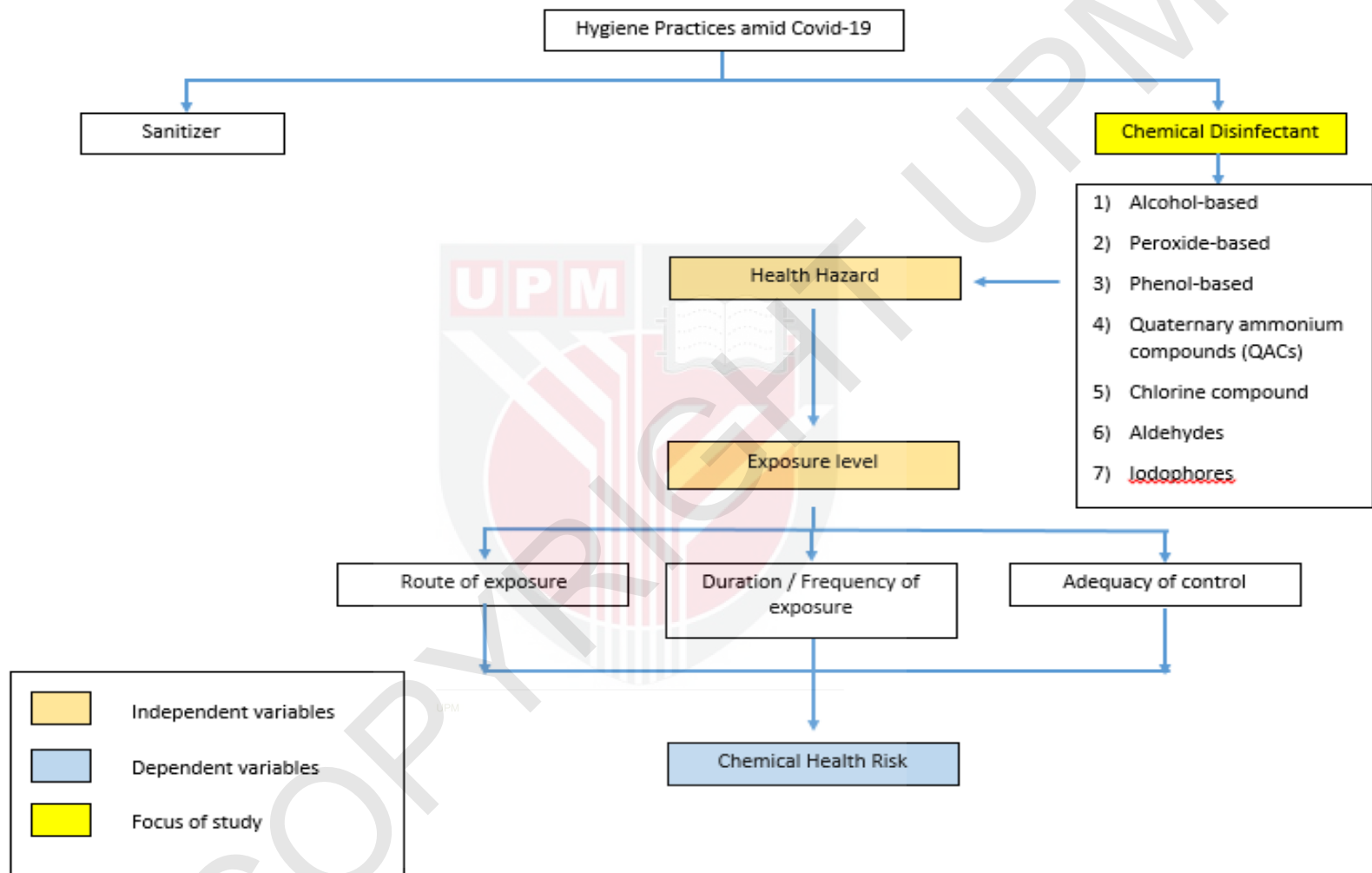


Figure 1.0: Conceptual Framework

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Coronavirus disease 19 (COVID-19) is a communicable disease that can be transmitted from one person to another. It is originated from Wuhan, China and has spread around the world (Al-Sayah, 2020). The epidemic started in the Hunan seafood market in the city of Wuhan, China. It sold exotics live animals such as bats, frogs, snakes, birds, marmots and rabbits. (Al-Sayah, 2020). The common symptom of this virus infection are cold, dry cough, fever, shortness of breath and other respiratory problems. An infected person also might be having serious symptom (e.g. severe acute respiratory syndrome, organ failure and death (Al-Sayah, 2020)

On 11th March 2020, the WHO formally declared it a pandemic and recommended taking preventive steps and practice healthy lifestyles to battle and remain safe from Covid-19. Furthermore, WHO advised community to practice good standards of personal hygiene by regularly washing their hands with soap for a minimum of 20 second or using disinfectants that can deactivate and destroy the virus and remove its infectivity to reduce the chances of infection (WHO, 2020).

2.2 The Usage of Chemical Disinfectants amid Covid-19 Pandemic

The recent widespread of Covid-19 virus worldwide has spurred mass attempts by states, municipal councils and public health agencies to conduct disinfection programs in public buildings and community-shared spaces (Al-Sayah, 2020). Multi-user items (e.g. shopping carts, elevator keys, door knobs, etc.) are considered high-risk areas for virus spread and thus require constant sterilization with appropriate use of chemical disinfectant (Al-Sayah, 2020). The Covid-19 virus can remain contagious on animate surfaces and serve as a source of infection during a period from 2 hours to 9 days with various types of materials (e.g. metal, wood and paper) (Kampf et al., 2020). However, the survival time of this virus depends on types of surface materials, relative humidity, temperature, and the virus strain (WHO, 2020). This is why surface disinfection provides enhanced protection to control the dissemination of SARS-CoV from inanimate surfaces (Rabenau et al., 2005)

Many type of the chemical disinfectants have been produced and sold during the Covid-19 pandemic. In general, there are seven main types of chemical disinfectants frequently used by consumers which are alcohol-based, peroxide-based, phenol-based, quaternary ammonium compounds (QACs), chlorine compound, aldehydes and iodophores (Al-Sayah, 2020). The alcohol-based disinfectants (ethanol, propan-2-ol, propan-1-ol) can be used to reduce virus infectivity at 70-80 percent concentrations of enveloped viruses such as Covid-19, with one minute exposure period (European Centre for Disease Prevention and Control, 2020). A study reported that the contaminated surfaces can be disinfected within a minute using common chemical disinfection methods and procedures with 62–71 percent of ethanol (Khan & Yadav, 2020).

Indeed, some factors must be considered before the selection of commercial chemical disinfectant which is the efficacy against Covid-19, safety profile, practicality (e.g. ease to use, surface compatibility), availability and cost (Tyan et al., 2020). The disinfection activity should be done at least once a day in an occupied space. The frequency of disinfection should be considered based on the occupancy and usage requirements (Washington, 2020). This is because over exposure and improper use of chemical disinfectants may lead to harmful effects on consumer's health (Yari et al., 2020)

2.3 The Chemical Health Hazard of Chemical Disinfectants

The information on the chemical health hazard of chemical disinfectants can be obtained from the ingredients which are usually stated on the products' label (3M Commercial Solution, 2014). Besides, the detailed information on hazard communication also can be identified from the Safety Data Sheet (SDS) and Materials Safety Data Sheets (MSDS) which contain information on chemical name, CAS no, classification code, hazard code (H-code) signal words and hazard pictogram (Department of Occupational Safety and Health Malaysia, 2014). All this information is located in Section 2 of SDS. It provides details on the hazard of the chemical and the likely consequences and symptoms when using them. This will aid in the estimation and assessment of the health risk to consumers (Health and Risk, 2018).

According to OSH (USECHH) Regulation 2000, any chemical posing a health hazard is called a hazardous chemical. Based on the, SDS the common chemical and physical hazard statement contain in the ingredients of commercial chemical disinfectants are flammable liquid and vapor, harmful in contact with skin or if inhaled,

may be harmful if swallowed, causes severe skin burns and eye damage, may cause respiratory irritation, etc. (CDC, 2020).

A common chemical disinfectant that widely used is made up of sodium hypochlorite. The recommended concentration of usage is 0.1 percent or 1,000 parts per million (Samara et al., 2020). Besides, alcohol may also be used for surface disinfection at 70 to 90 percent strength. However, it can cause acute health hazard to consumers (e.g. skin and eye inflammation, irritation to the respiratory tract, and asthma) (WHO, 2020). However, certain chemicals can be retained in our bodies for a long time when we are exposed to small concentrations continuously. After a few years later, these persistent chemicals can cause chronic effect such as cancer and asthma (Leonard et al., 2013)

2.4 The Route of Exposure of Chemical Disinfectants

Humans are exposed to chemical disinfectants during and post disinfection activities. They can inhale the disinfectant into the lungs. Inhalation was the main route of exposure, which rose significantly by 35.3 percent over the first few months of the COVID-19 pandemic (Chang et al., 2020). Besides, consumers also absorb the chemical disinfectant via dermal absorption through the epidermis layer on the skin. Then, they will eventually enter the blood circulatory system and cause an acute and toxic effect. However, the exposure time can be reduced by washing hands regularly with soap (Li et al., 2020).

Chemical disinfectants also can enter consumers' bodies by ingestion. It happens when they accidentally touching or rubbing the disinfected surface or area (surface-to-hand transfer). Then, further transmission can occur when they having subsequent mouthing, licking, or biting of hands that contain the chemical hazardous to health (hand-to-mouth transfer). Direct mouthing of disinfected items such as toys often results in oral absorption of chemical disinfectants (object-to-mouth transfer). For babies and toddlers, such mouthing-mediated exposure may be of greater concern when they mouth almost all while exploring the setting (Li et al., 2020).

2.5 The Chemical Health Risk of Chemical Disinfectants

The adverse health impact poses by the frequent use of chemical disinfectant can be categorized into acute adverse reactions and chronic health effects (Tina, 2020). Acute reactions can be the result of disinfectants being misused and overused while chronic health effects may be due to long-term exposure.

2.5.1 Acute Health Effect

The National Poison Data System has recorded a significant rise in cases of disinfection poisoning during the latest COVID-19 pandemic. Cases linked to exposure to poisoning found that chlorine products (62.1%) accounted for the highest amount of poisoning before and after COVID-19, followed by non-alcohol disinfectants (36.7%) and hand sanitizers (367%) (Samara et al., 2020). Exposures in children aged 5 years and above were correlated with a significant percentage of total cases (Chang et al., 2020)

The National Poison Data System also reported an adult woman experienced breathing difficulties, coughing, and wheezing when accidentally smell chlorine gases from the disinfectants. Then, she was taken by ambulance to the emergency room (ED) and was noted to have moderate hypoxemia and end-expiratory wheezing (Chang et al., 2020). This is because the chemical reaction between sodium hypochlorite (active ingredients contained in the chemical disinfectants) with ammonia will produce chloramine gases. This gas can cause symptoms such as cough, shortness of breath, chest pain, wheezing, nausea, watery eyes, inflammation of the mouth, nose and eyes, and lung pneumonia (Tina, 2020)

A few individuals also had reported using the chemical disinfectants for washing their food products and applied them to their skin. These kind of behavior are very dangerous and can cause severe health problems such as permanent blindness, seizures, coma and permanent injury to the nervous system or death (Rai et al., 2020). Besides, chemical disinfectants are very hard on the skin and can cause skin, eyes, and other body parts to get irritated. It is also reported that ingestion of the disinfectants can causes hypernatremia, hypochloroemia, acute respiratory distress syndrome (ARDS) and lung injury. (Rai et al., 2020) Besides, exposure to chemical disinfectants has also been reported to cause mucosal erosion, gastrointestinal inflammation, ear, nose, and throat lesions, and symptoms of asthma. Glutaraldehyde and ethylene oxide also has been proved to cause serious lung disease (Dumas et al., 2019).

2.5.2 Chronic Health Effect

In fact, chemical residues that are left on a disinfected surface will become airborne which can be inhaled into the lungs. It also can cause poor indoor air quality with consequences for asthmatic and allergic especially for susceptible individuals (Rai et al., 2020). These residues include chemicals that may contribute to tumors, reproductive disorders, respiratory ailments, impairment of the central nervous system (CNS), oxidative damage and other chronic health effects. On the other hand, quaternary ammonium disinfectants (Quats) have been found to cause fertility in male and female reproductive systems (Melin et al., 2016). Also, chlorine-based disinfectants could have a chemical reaction with nitrogen and form chloramine or N-nitrosodi-methylamine. This compound was identified as carcinogenic to humans (Rai et al., 2020). Besides, epidemiological research has reported that there is a statistically

strong association between prenatal exposure to domestic chemical products and chronic wheezing in young children up to the age of 3.5 years (Rabenau et al., 2005).

2.6 Chemical Health Risk Assessment as the Tools of Estimating Potential Health Risks of Chemical Disinfectants to Consumers

Manual of Recommended Practice on Assessment of the Health Risks Arising from the Use of Chemicals Hazardous to Health at Workplace 2017 provides a standard procedure to perform a complete assessment by using a Chemical Health Risk Assessment method (CHRA Manual, 3rd ed, 2017). This method can be used as a tool for estimating the potential health risks of chemical disinfectants to consumers as it helps to identify the potential hazards posed by each chemical hazardous to health, CHTH. Next, this method can evaluate the degree of exposure of consumers to the hazardous chemicals contains in the disinfectants either through inhalation, dermal, or ingestion. It also provides information on the frequency and duration of chemical hazardous to health exposure to the consumers. So, the evaluation of risk level for dermal and inhalation exposure can be determined based on the hazardous exposure details and risk rating are derived from hazard rating and exposure rating. Therefore, the decisions on appropriate control measures and evaluation of the steps to be taken to minimize or mitigate the health risks of the chemical disinfectants can be done (CHRA Manual, 3rd ed, 2017).

CHAPTER 3

METHODOLOGY

3.1 Variables of the Study

- 1) Independent variable: The health hazard of the commercial chemical disinfectant and exposure level while handling the chemical disinfectants.
- 2) Dependent variables: The level of health risk arising from the frequent usage of commercial chemical disinfectant during the Covid-19 pandemic.

3.2 Study Design

A descriptive study was used to determine the potential health risk of commercial chemical disinfectants due to their chemical composition used and their exposure levels by consumers amid the Covid-19 pandemic. This study was designed based on the (1) Industry Code of Practice (ICOP) on Chemicals Classification and Hazard Communication 2014 and (2) Manual of Recommended Practice on Assessment of the Health Risks Arising from the Use of Chemicals Hazardous to Health at Workplace 2017, due to its suitability to estimate the outcome of chemical health risk of commercial chemical disinfectant during Covid-19 pandemic (Department of Occupational Safety and Health Malaysia, 2014)

3.3 Sampling Method

Non-probability sampling whereby convenience sampling was applied to select the commercial chemical disinfectants based on the inclusion and exclusion criteria (Refer Section 3.5) to obtain the desired information required to assess the chemical health risks.

3.4 Sample Size Estimation

According to Delice, 2001 the sample size required for descriptive study design should not be less than 30. Moreover, a sample size between 30 to 500 at a 5% of confidence level is generally sufficient for the descriptive research study. Plus, the decision on the size should reflect the quality of the sample in this wide interval (Delice, 2001). Therefore, a total of 50 types of commercial chemical disinfectants were purchased from various types of vendors sold in Malaysia's market throughout the pandemic period. 25 samples were purchased from an online shop whilst the remaining was purchased from physical stores such as drugstore, grocery store, pharmacy or any convenience store.

3.5 Inclusion and Exclusion Criteria

The inclusion and exclusion criteria have been considered for the selection of commercial chemical disinfectants used in this study. Table 3.1 below shows the inclusion and exclusion criteria include for this study.

Table 3.1: Inclusion and Exclusion Criteria

Inclusion Criteria	Exclusion Criteria
<p>1) Commercial chemical disinfectants that contain ingredients label on the packaging.</p> <p>2) Type of chemical disinfectants:</p> <ul style="list-style-type: none"> • Alcohol-based • Peroxide-based • Phenol-based • Quaternary ammonium compounds (QACs) • Chlorine compound • Aldehydes • Iodophores <p>3) Local and imported chemical disinfectants sold in Malaysia.</p> <p>4) Size of chemical disinfectants included from travel size (30mL) until large size (500mL)</p>	<p>1) Commercial chemical disinfectants that do not contain ingredients label on the packaging.</p>

3.6 Materials and Instrumentation

Materials and instrumentations used included a Manual of Recommended Practice on Assessment of the Health Risks Arising from the Use of Chemicals Hazardous to Health at Workplace 2017 to adopt the CHRA method as a tool for this study. Form B (Refer Appendix 1) was used to assess the chemical hazardous to health while Form C (Refer Appendix 2) was used to determine the exposure level of chemical disinfectants in this study. Moreover, the Industry Code of Practice (ICOP) on Chemicals Classification and Hazard Communication 2014 was used to assess the health hazard classification of the chemical disinfectants. For the chemical ingredients that were not listed in ICOP, PubChem which is the world's largest website for free collection of chemical databases was used to assess the health hazard classification of the disinfectants. They were assessed from its safety label or Safety Data Sheet (SDS) to gather some information required for the chemical health risk assessment. The information includes the list of ingredients, the volume of the products, the usage direction, H- codes, hazard statement, and pictogram.

3.7 Data Collection

The type of data collection in this study is secondary data collection. A total of 50 samples of commercial chemical disinfectants were purchased based on inclusion and exclusion criteria. 25 samples of them were purchased from various types of physical stores (pharmacies, drug stores, etc.) whilst the remaining were purchased from the online shop (Shopee, Lazada, Mudah.my, etc.). The source of the information was gathered from documents and records (e.g. from the label and SDS) of the chemical disinfectants. The brand and logo of the product were not disclosed in this study due

to copyright issues, instead only stated whether the product is manufactured locally or imported.

3.8 Quality Assurance

Quality Assurance was considered to ensure the quality of this study so that it is valid and reliable for result generalization. The methodology of this study is based on the method adopted from the CHRA manual (CHRA Manual, 3rd ed. 2017). All the procedures conducted in this study were monitored and endorsed by the competent CHRA assessor.

3.9 Methodology and Procedure

3.9.1 Examine the Background and Ingredients of the Commercial Chemical Disinfectants

There are 50 samples of commercial chemical disinfectants that were purchased from various types of vendors that are sold in the Malaysia market during the Covid-19 pandemic based on the inclusion and exclusion criteria that have been decided. The vendors include physical stores (Pharmacies, drug stores, groceries, etc.) and e-commerce platforms such as Shopee, Lazada, Mudah.my, etc. Then, some information was gathered from chemical disinfectants' labels and SDS to examine the background and ingredients of the disinfectants. The information gathered was recorded in **Table 3.2: The Baseline Information of Chemical Disinfectants.**

Table 3.2: The Baseline Information of Chemical Disinfectants.

No.	Product Name	Manufacturer	Price range (RM)	Type of shop purchased (pharmacies, drug store, grocery shop,online shop)	SDS Provided (Y/N)	Ingredients	Volume of product	Physical properties (gel, liquid, gas)	Usage Direction	Hazard Statement	Pictogram

3.9.2 Examine the Health Hazard Classification of Ingredients Contained in Chemical Disinfectants

After some information has been recorded in Table 3.2, then the health hazard classification of ingredients contained in chemical disinfectant was analyzed. In order to determine the health hazard classification, we referred to the Industry Code of Practice (ICOP) on Chemicals Classification and Hazard Communication, 2014, PubChem website (PubChem, 2021) and the Manual of Recommended Practice on Assessment of the Health Risks Arising from the Use of Chemicals Hazardous to Health at Workplace, 2017. The Chemicals Hazardous to Health (CHTH) were identified based on ICOP 2014 and the information of CHTH was recorded in **Table 3.3: Hazard Rating of Chemical Disinfectants** which is adopted from Form B: List of CHTH (Refer Appendix 1), Manual of Recommended Practice on Assessment of the Health Risks Arising from the Use of Chemicals Hazardous to Health at Workplace, 2017 (CHRA Manual, 2017).

Table 3.3: Hazard Rating of Chemical Disinfectants

No	Name of the product	Hazardous Ingredient	Hazard classification	H-code	Source of information	HR	Dermal (Y/N)	Ingestion (Y/N)

For the route of exposure through inhalation, the degree of hazard was rated on a scale of 1 to 5. Rating of 1 implying the least adverse health effects and rating 5 implying the most severe adverse health effect of the CHTH. The hazard rating (HR) was used to prioritize hazards based on the potential health effect of the CHTH. To determine HR, **Table 3.4: Hazard Rating for Inhalation Exposure Based on Health Effect, Hazard Classification, H-Code and Acute Toxicity Data** was referred to complete the **Table 3.3: Hazard Rating of Chemical Disinfectants**. Among the listed HR assigned, the highest HR for the CHTH was selected.

Table 3.4: Hazard Rating for Inhalation Exposure Based on Health Effect, Hazard Classification, H-Code and Acute Toxicity Data

HR	Health Effects	Hazard Classification	H-code	Acute toxicity
5	<ul style="list-style-type: none"> • Injury of sufficient severity to threaten life by single exposure; • Causing fatality at low doses or concentration; • Severe irreversible effects (e.g. central nervous system effects, kidney necrosis, liver lesions, anaemia or paralysis) after a single exposure; 	Acute toxicity category 1 (inhalation)	H330	$LC_{50} \leq 0.5$ mg/l (vapours) $LC_{50} \leq 100$ ppmV (gases)
		Carcinogenicity category 1A	H350, H350i	$LC_{50} \leq 0.05$ mg/l (dusts/mists)
		Mutagenicity category 1A	H340	

	<ul style="list-style-type: none"> • Known to have carcinogenic potential for humans; • Known to induce heritable mutations in the germ cells of humans; • Known human reproductive toxicant. 	<p>Reproductive toxicity category 1A</p>	<p>H360, H360D, H360F, H360FD, H360Fd, H360Df</p>	
		<p>Specific target organ toxicity – single exposure category 1</p>	<p>H370</p>	
4	<ul style="list-style-type: none"> • Injury of sufficient severity to cause permanent impairment, disfigurement or irreversible change from single or repeated exposure; • Very serious physical or health impairment by repeated or prolonged exposure; • Serious damage to target organ from single exposure • Presumed to have carcinogenic potential for humans; • Chemicals which should be regarded as if they induce heritable mutations 	<p>Acute toxicity category 2 (inhalation)</p>	<p>H330</p>	<p>$0.5 < LC_{50} \leq 2.0$ mg/l (vapours)</p> <p>$100 < LC_{50} \leq 500$ ppmV (gases)</p> <p>$0.05 < LC_{50} \leq 0.5$ mg/l (dusts/mists)</p>
		<p>Carcinogenicity category 1B</p>	<p>H350, H350i</p>	
		<p>Mutagenicity category 1B</p>	<p>H340</p>	
		<p>Reproductive toxicity category 1B</p>	<p>H360, H360D, H360F, H360FD, H360Fd, H360Df</p>	

	<p>in the germ cells of humans;</p> <ul style="list-style-type: none"> • Presumed human reproductive toxicant. 	Effects on or via lactation	H362	
		Specific target organ toxicity – repeated exposure category 1	H372	
		Respiratory sensitisation category 1	H334	
3	<ul style="list-style-type: none"> • Serious damage organ from single or repeated exposure; • Toxic effects after exposure; • Suspected human carcinogens; • Chemicals which cause concern for humans owing to the possibility that they may induce heritable mutations in the germ cells of humans; • Suspected human reproductive toxicant; • Effect to respiratory tract after single exposure 	Acute toxicity category 3 (inhalation)	H331	<p>$2 < LC_{50} \leq 10$ mg/l (vapours)</p> <p>$500 < LC_{50} \leq 2500$ ppmV (gases)</p>
		Carcinogenicity category 2	H351	$0.5 < LC_{50} \leq 1$ mg/l (dusts/mists)
		Mutagenicity category 2	H341	
		Reproductive toxicity category 2	H361, H361f, H361d, H361fd	

		Specific target organ toxicity – repeated exposure category 2	H373	
		Specific target organ toxicity – single exposure category 3 (<i>respiratory tract irritation</i>)	H335	
2	<ul style="list-style-type: none"> • Reversible effects, not severe enough to cause serious health impairment; • Changes readily reversible once exposure ceases. • Harmful effects after exposure 	Acute toxicity category 4 (inhalation)	H332	10 < LC ₅₀ ≤ 20 mg/l (vapours)
		Specific target organ toxicity – single exposure category 3 (<i>narcotic effect</i>)	H336	2500 < LC ₅₀ ≤ 20000 ppmV (gases) 1 < LC ₅₀ ≤ 5 mg/l (dusts/mists)
1	<ul style="list-style-type: none"> • Minimal adverse health effects 	Chemical not otherwise classified	H333	LC ₅₀ > 20 mg/l (vapours) LC ₅₀ > 20000 ppmV (gases) LC ₅₀ > 5 mg/l (dusts/mists)

Note. Adapted from Manual of Recommended Practice on Assessment of the Health Risk Arising from the Use of Chemicals Hazardous to Health at Workplace 3rd Edition (p.29), by Department of Occupational Safety and Health, Ministry of Human Resources Malaysia, 2017.

Degree of hazard for dermal exposure was categorized by the effect of chemicals to dermal (skin and eyes). Health effect of chemicals by dermal exposure could be categorized based on the hazardous properties as irritation, corrosion, sensitization or skin-absorption and other properties (refer **Table 3.4: Hazardous Properties Relevant to Dermal Exposure**)

Table 3.5: Hazardous Properties Relevant to Dermal Exposure

Hazardous Properties	Description	Corresponding hazard classification and H-code
Irritation	Chemicals which is irritating to skin or eyes after contact	<ul style="list-style-type: none"> • Skin corrosion or irritation category 2 (H315) • Serious eye damage or eye irritation category 2 (H319)
Corrosion	Chemicals which have damaging effect on skin or eyes after contact	<ul style="list-style-type: none"> • Skin corrosion or irritation category 1 (H314) • Serious eye damage or eye irritation category 1 (H318)
Sensitisation	Chemicals which lead to allergic response following skin contact	<ul style="list-style-type: none"> • Skin sensitisation category 1 (H317)
Acute toxicity	Chemicals which cause adverse effect following dermal administration of a single dose of a chemical or multiple dose given within 24 hours	<ul style="list-style-type: none"> • Acute toxicity (dermal) category 1 (H310) • Acute toxicity (dermal) category 2 (H310) • Acute toxicity (dermal) category 3 (H311) • Acute toxicity (dermal) category 4 (H312)

<p>Skin- absorption and other properties</p>	<p>Enter human body through dermal due to their physical chemical properties;</p> <p>Dermal application studies shown that absorption could cause systemic effect.</p>	<ul style="list-style-type: none"> • Specific target organ toxicity-single exposure category 1* (H370) • Specific target organ toxicity-single exposure category 2* (H371) • Specific target organ toxicity-repeated exposure category 1* (H372) • Specific target organ toxicity-repeated exposure category 2* (H373) • Carcinogenicity category 1* (H350) • Carcinogenicity category 2* (H351) • Germ cell mutagenicity category 1* (H340) • Germ cell mutagenicity category 2* (H341) • Reproductive toxicity category 1* (H360, H360D, H360F, H360FD, H360Fd, H360Df) • Reproductive toxicity category 2* (H361, H361f, H361d, H361fd)
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Note. Adapted from Manual of Recommended Practice on Assessment of the Health Risk Arising from the Use of Chemicals Hazardous to Health at Workplace 3rd Edition (p.31), by Department of Occupational Safety and Health, Ministry of Human Resources Malaysia, 2017.

3.9.3 Assess the Possible Routes of Exposure of Commercial Chemical Disinfectants

Next, **Table 3.6: Exposure Rating for Inhalation** and **Table 3.13: Dermal Assessment** were filled in order to assess the possible routes of exposure of commercial chemical disinfectant. The tables were separated into two categories which are for inhalation exposure (adopted from Form C1: Inhalation exposure assessment) and dermal exposure (adopted from Form C3: Dermal assessment) (Refer Appendix 2).

1) Inhalation Exposure

Table 3.6: Exposure Rating for Inhalation

Product Code	FR	DR	FDR	Degree of release or exposure level	Degree of chemical inhaled	MR	ER	HR	RR

Exposure rating (ER) was used to represent the degree of exposure to CHTH by taking into account the frequency of exposure (refer **Table 3.7: Frequency Rating**), duration of exposure (refer **Table 3.8: Duration Rating**), frequency of exposure and duration (refer **Table 3.9: Frequency-Duration Rating**) to assign FDR (CHRA Manual, 2017).

Table 3.7: Frequency Rating

Rating	Description	Definition
5	Frequent	Exposure one or more time per shift or per day
4	Probable	Exposure greater than one time per week
3	Occasional	Exposure greater than one time per month
2	Remote	Exposure greater than one time per year
1	Improbable	Exposure once per year or less

Table 3.8: Duration Rating

Rating	Duration of exposure per shift (x)
5	$x \geq 7$ hours
4	$4 \leq x < 7$ hours
3	$2 \leq x < 4$ hours
2	$1 \leq x < 2$ hours
1	$x < 1$ hour

Note: Table 5 and 6 were adapted from Manual of Recommended Practice on Assessment of the Health Risk Arising from the Use of Chemicals Hazardous to Health at Workplace 3rd Edition (p.43), by Department of Occupational Safety and Health, Ministry of Human Resources Malaysia, 2017.

Table 3.9: Frequency-Duration Rating

		Frequency Rating (FR)				
		1	2	3	4	5
Duration Rating (DR)	1	1	2	2	2	3
	2	2	2	3	3	4
	3	2	3	3	4	4
	4	2	3	4	4	5
	5	3	4	4	5	5

Note: Adapted from Manual of Recommended Practice on Assessment of the Health Risk Arising from the Use of Chemicals Hazardous to Health at Workplace 3rd Edition (p.44), by Department of Occupational Safety and Health, Ministry of Human Resources Malaysia, 2017.

Then, Magnitude rating (MR) was determined by the chemical's physicochemical properties and human interface during chemical handling. It was assessed by estimating the degree of chemical released or presence and the degree of chemical inhaled. Through observation, the degree of chemical release or presence (refer **Table 3.10: Degree of Chemical Release or Presence**) was estimated from the physicochemical properties, quantity used and the method of handling. The degree varies from low, moderate and high. For this study, this value was selected as moderate for chemical disinfectants. As for the degree of chemical inhaled, CHTH in the form of vapours, gases, mists or particulates was having inhalation as their main route of

exposure into our body. To evaluate the degree of chemicals being inhaled, **Table 3.11: Degree of Chemical Inhaled** is used. Once the degree of chemical released or presence and degree of chemical inhaled have been obtained, the magnitude rating (MR) can be determined using **Table 3.12: Magnitude Rating**. Based on the FDR and the MR, an ER was assigned using **Table 3.13: Exposure Rating** (CHRA Manual, 2017).



Table 3.10: Degree of Chemical Release or Presence

Degree	Observation
Low	<ul style="list-style-type: none"> • Low or little release into the air. • No contamination of air, clothing and work surfaces with chemicals. • Low volatility with the boiling point more than 150°C at room temperature (20°C). • Low dustiness such as pellet like solids that don't break up. Little dust is seen during use.
Moderate	<ul style="list-style-type: none"> • Moderate release such as: <ul style="list-style-type: none"> a) Solvents with medium drying time in uncovered containers or exposed to work environment; b) Detectable odour of chemicals. Check the odour threshold. • Medium volatility with the boiling point at 50°C to 150°C at room temperature (20 °C). • Medium dustiness such as crystalline, granular solids. When used, dust is seen, but settles out quickly. Dust is left on surfaces after use e.g. soap powder. • Evidence of contamination of air, clothing and work surfaces with chemicals.
High	<ul style="list-style-type: none"> • Substantial release such as: <ul style="list-style-type: none"> a) Solvents with fast drying time in uncovered containers; b) Sprays or dust clouds in poorly ventilated areas; c) Chemicals with high rates of evaporation exposed to work environment; d) Detectable odour of chemicals with odour threshold at/above PEL/OEL. • High volatility with the boiling point less than 50°C at room temperature (20 °C).

	<ul style="list-style-type: none"> • High dustiness such as fine, light powders. When used, dust clouds can be seen to form and remain in the air for several minutes e.g. cement, carbon black, chalk dust. • Gross contamination of air, clothing and work surfaces with chemicals.
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Note: Adapted from Manual of Recommended Practice on Assessment of the Health Risk Arising from the Use of Chemicals Hazardous to Health at Workplace 3rd Edition (p.45), by Department of Occupational Safety and Health, Ministry of Human Resources Malaysia, 2017.

Table 3.11: Degree of Chemical Inhaled

Degree	Observation/ Condition
Low	<ul style="list-style-type: none"> • Source far from breathing zone
Moderate	<ul style="list-style-type: none"> • Source close to breathing zone
High	<ul style="list-style-type: none"> • Source within breathing zone

Note: Adapted from Manual of Recommended Practice on Assessment of the Health Risk Arising from the Use of Chemicals Hazardous to Health at Workplace 3rd Edition (p.47), by Department of Occupational Safety and Health, Ministry of Human Resources Malaysia, 2017.

Table 3.12: Magnitude Rating

		Degree of Inhaled		
		LOW	MODERATE	HIGH
Degree of Release/Presence	LOW	1	2	3
	MODERATE	2	3	4
	HIGH	3	4	5

Note: Adapted from Manual of Recommended Practice on Assessment of the Health Risk Arising from the Use of Chemicals Hazardous to Health at Workplace 3rd Edition (p.48), by Department of Occupational Safety and Health, Ministry of Human Resources Malaysia, 2017.

Table 3.13: Exposure Rating (ER)

		Magnitude Rating (MR)				
		1	2	3	4	5
Frequency-Duration Rating (FDR)	1	1	2	2	2	3
	2	2	2	3	3	4
	3	2	3	3	4	4
	4	2	3	4	4	5
	5	3	4	4	5	5

Note: Adapted from Manual of Recommended Practice on Assessment of the Health Risk Arising from the Use of Chemicals Hazardous to Health at Workplace 3rd Edition (p.49), by Department of Occupational Safety and Health, Ministry of Human Resources Malaysia, 2017.

2) Dermal Exposure

Table 3.14: Dermal Assessment

Product Code	Hazardous Properties	Extent of dermal contact	Duration of exposure		Level of Risk
			Short term (<15 min/shift)	Long term (≥15 min/shift)	
				Chemical disinfectant	

Dermal exposure pathways included direct dermal contact, hand immersion into CHTH, deposition of CHTH airborne, contact with the disinfected surface and chemical splash on body. The example of hazard properties are irritation, corrosive, sensitization, acute toxicity, skin absorption and other properties. There are two factors to evaluate the degree of dermal exposure which are the extent of dermal contact and duration of contact. Extent of dermal contact was categorized into small and large areas. On the other hand, the duration of dermal contact included short term (<15 min/shift) and long term (≥15 min/shift). The information on level of risk was determined based on **Table 3.15: Risk Matrix for Dermal Exposure** (CHRA Manual, 2017).

For this study, the exposure duration of commercial chemical disinfectants was long exposure. The level of risk for dermal exposure is determined based on three categories which are low (L), Moderate (M1 & M2) and high risk (H1 & H2). These categories of risk level were determined by referring to **Table 3.15: Risk Matrix for**

Dermal Exposure (CHRA Manual, 2017). Therefore, the product with the assigned level of risk determination were recorded in **Table 3.16: The Level of Health Risk**.

Table 3.15: Risk Matrix for Dermal Exposure

Hazardous properties	Relevant H-code	Duration/ Extent of skin contact			
		Short-term (<15min)		Long-term (≥ 15min)	
		Small area	Large area	Small area	Large area
Irritation	H315	L	M1	M1	M2
	H319	M1		M2	
Corrosive	H314	M1	H1	H1	H2
	H318	H1		H2	
Sensitisation	H317	L	M1	M2	H1
Acute toxicity	H312	M1	M1	M1	H1
	H311	M1	M1	M2	H1
	H310	H1	H1	H1	H1
Combination effect*	H310 with H314	H1	H1	H1	H1
	H351	M1	M1	M2	H1

Skin absorption and other properties**	H350	H1	H1	H1	H2
	H341	M1	M1	M2	H1
	H340	H1	H1	H1	H2
	H361, H361f, H361d, H361fd	M1	M1		H1
	H360, H360F, H360D, H360FD, H360Fd, H360fD	H1	H1	H1	H2
	H370	H1	H1	H1	H2
	H371	M1	M2	M2	H1
	H372	M1	M1	M2	H1
	H373	L	M1	M2	M2

L: Low risk

M: Moderate risk

H: High risk

Note:

1. *For chemicals classified both as acute toxicity (dermal) category 1 or 2 and skin corrosion or irritation category 1 (1A/1B/1C);
2. **If indicate as skin absorption or effect is due to dermal exposure;
3. M2 and H2 indicating higher risk compare with M1 and H1 thus to be consider when deciding priority of action to control exposure i.e. M2 is higher moderate risk compare to M1 and H2 is higher high risk compare to H1.

3.9.4 Determine the Level of Health Risk Potentially Arising from the Usage of Commercial Chemical Disinfectant

The level of risk for inhalation exposure was determined based on risk rating (refer **Table 3.16: Level of Risk Determination**), which was derived from the HR and ER. The risk rating was determined using the following equation: $RR = HR \times ER$. Where, RR was the risk rating (1 to 25) indicating the likelihood of illness; HR was the hazard rating (1 to 5) indicating the severity of adverse effects; and ER was the exposure rating (1 to 5) indicating the chance of overexposure to the CHTH. The level of risk was determined based on the result of RR which were: Low Risk (RR= 1 to RR=4); moderate risk (RR= 5 to RR=12) and high risk (RR= 15 to RR=25).

Table 3.16: Level of Risk Determination

		Exposure Rating (ER)				
		1	2	3	4	5
Hazard Rating (HR)	1	RR=1	RR=2	RR=3	RR=4	RR=5
	2	RR=2	RR=4	RR=6	RR=8	RR=10
	3	RR=3	RR=6	RR=9	RR=12	RR=15
	4	RR=4	RR=8	RR=12	RR=16	RR=20
	5	RR=5	RR=10	RR=15	RR=20	RR=25

Note: Adapted from Manual of Recommended Practice on Assessment of the Health Risk Arising from the Use of Chemicals Hazardous to Health at Workplace 3rd Edition (p.54), by Department of Occupational Safety and Health, Ministry of Human Resources Malaysia, 2017.

The level of risk is determined based on the result of RR which are:

Low risk	RR= 1 to RR=4
Moderate risk	RR= 5 to RR=12
High risk	RR= 15 to RR=25

Therefore, the product with the assigned level of risk determination will be recorded in **Table 3.17: The Level of Health Risk**.

Table 3.17: The Level of Health Risk

Product Code	RR (inhalation)	Level of Risk Determination for Inhalation Exposure (RR = HR x ER)			Risk for Dermal Exposure		
		Low risk (RR= 1-4)	Moderate risk (RR= 5- 12)	High risk (RR= 15-25)	Low Risk (L)	Moderate risk (M1 & M2)	High Risk (H1 & H2)

Lastly, based on the result obtained, some recommendation and appropriate control measure were suggested in order to minimize the exposure level of chemical disinfectants. At the same time, the potential of health risk poses due to frequent usage of commercial chemical disinfectants can be reduced.

3.9.5 Research Flowchart

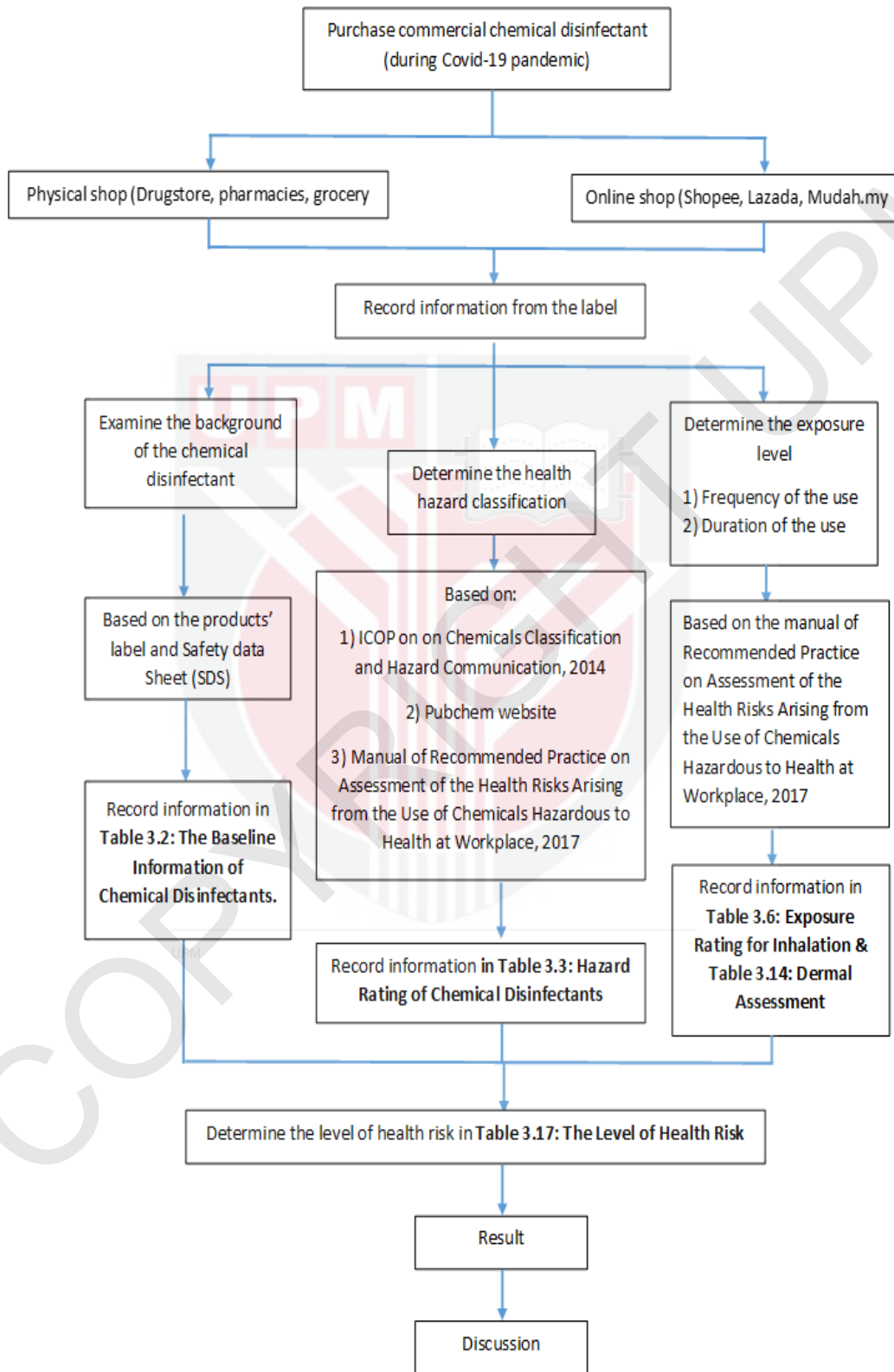


Figure 3.0: Research Flowchart

3.10 Data Analysis

Descriptive statistics were performed using Microsoft Excel 365 (Microsoft Inc. USA). Results were presented as pie charts and bar graphs to describe the basic features of the data in the study. Descriptive Statistics was used to present quantitative descriptions in a manageable form. Moreover, descriptive statistics will assist to simplify large amounts of data in sensibly. Each descriptive statistic reduces lots of data into a simpler summary such as graphs to represent the data.



CHAPTER 4

RESULT

4.1 The Background Ingredients of the Commercial Chemical Disinfectants.

There are 50 samples of chemical disinfectants that have been analyzed based on the CHRA method. As the result, there are eight (8) main types of active ingredients with different percent of concentration levels (%) contained in each of the disinfectants. They were **benzalkonium chloride, isopropyl alcohol, ethanol, chloroxylenol, quaternary ammonium compound (didecyl dimethyl ammonium chloride, and dimethyl ethylbenzyl ammonium chloride), hypochlorous acid and sodium dodecyl benzene sulphate**. Among all of the samples, there are 41 of them have only one active ingredient, meanwhile, another 9 samples have a mixture of two different active ingredients.

Table 4.1: The List of Active Ingredients in the Chemical Disinfectants

No	Active Ingredients	Number of Chemical Disinfectants	Concentration Level (%)
1.	Isopropyl Alcohol	14	<10% - 80%
2.	Ethanol	12	1 – 80%
3.	Benzalkonium chloride	10	<1% - 60%
4.	Benzethonium chloride	1	0.07%-0.09%
5.	Chloroxylenol	1	0.8%
6.	Quaternary ammonium compound	1	0.3%
7.	Hypochlorous acid	1	0.015%
8.	Sodium dodecyl benzene sulphate	1	1-5%

Table 4.2: The List of Mixture of Active Ingredients in the Chemical Disinfectants

No	Active Ingredients	Number of Chemical Disinfectants	Average Concentration Level (%)
1.	Didecyl Dimethyl Ammonium Chloride + Benzalkonium Chloride	3	<1%
2.	Isopropyl Alcohol + Ethanol	2	<70%
3.	Ethanol + Biocide	1	Unknown concentration
4.	Ethanol + Benzalkonium chloride	1	<6%
5.	Ethanol + Quartenary Ammonium Compound	1	Unknown concentration
6.	Dimethyl ethylbenzyl ammonium chloride + Didecyl dimethyl ammonium chloride	1	64%

The highest number of active ingredients used in the chemical disinfectants was isopropyl alcohol (14), followed by ethanol (12) and benzalkonium chloride (10). The least number of active ingredients contained in the chemical disinfectants were benzethonium chloride, chloroxylenol, quartenary ammonium compound, hypochlorous acid and sodium dodecyl benzene sulphate which was 1 respectively. However, the highest number the mixture of active ingredients was didecyl dimethyl ammonium chloride + benzalkonium chloride (3) then followed by Isopropyl Alcohol + Ethanol (2). The others mixture was 1 respectively.

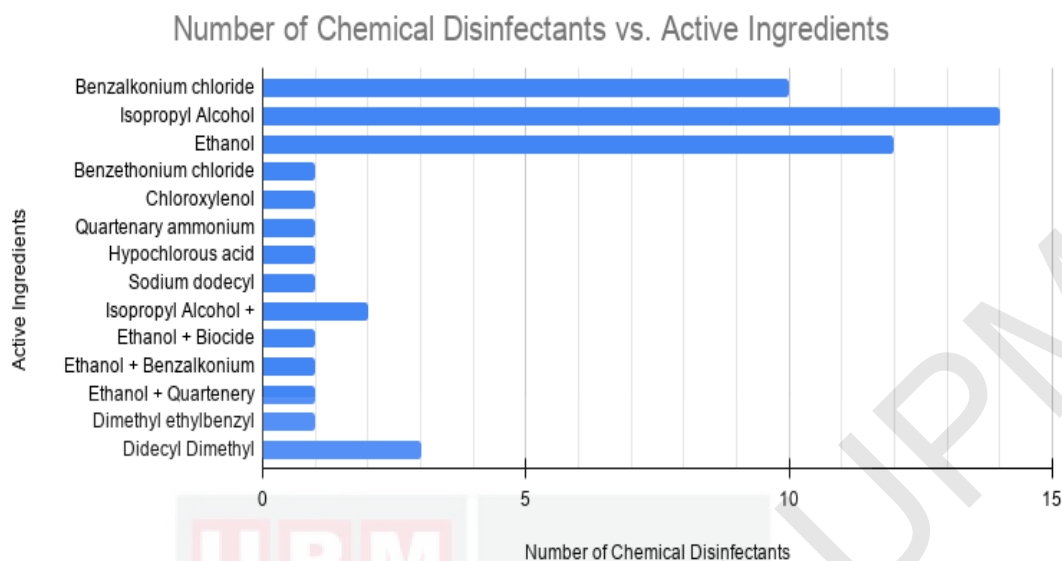


Figure 4.1: The Active Ingredients Contained in the Chemical Disinfectants

4.2 The Health Hazards of Chemical Ingredients Contained in the Commercial Chemical Disinfectants.

H-code is very crucial to determine the health hazard classification of the chemical disinfectants. However, in the situation where it was not possible to classify the substances or mixture due to insufficient and no data available, the substance or mixture should be designated as “Classification Not Possible”. In this study, six chemical disinfectants couldn’t proceed for further analysis due to lack of information such as concentration level (%), H code, toxicological and safety information.

On the other hand, the health hazard classification that has been identified in the 44 samples were acute toxicity (oral) Cat. 3, acute toxicity (oral) Cat. 4, acute toxicity (dermal) Cat. 4, acute toxicity (inhalation) Cat. 4, skin corrosion/irritation Cat. 1, skin corrosion/irritation Cat. 2, serious eye damage/ irritation Cat. 1, Serious eye damage/ irritation Cat. 2A, serious eye damage/ irritation Cat. 2B, respiratory sensitization Cat.

1, skin Sensitation Cat. 1, carcinogenicity Cat. 1, STOT-SE Cat. 2, STOT-SE Cat. 3 and aspiration hazard Cat. 2.

Table 4. 3: Health Hazard Classification of Chemical Disinfectants

No.	H-code / Health Hazard Classification	Hazard Statement	Number of Chemical Disinfectants
1.	H302 / Acute toxicity (oral) Cat. 4	Harmful if swallowed	25
2.	H319 / Serious eye damage/irritation Cat. 2A	Causes serious eye irritation	23
3.	H336 / STOT-SE Cat. 3	May cause drowsiness or dizziness	21
4.	H320 / Serious eye damage/irritation Cat. 2B	Causes eye irritation	18
5.	H315 / Skin corrosion/irritation Cat. 2	Causes skin irritation.	16
6.	H312 / Acute toxicity (dermal) Cat. 4	Harmful in contact with skin.	7
7.	H318 / Serious eye damage/irritation Cat. 1	Causes serious eye damage	5
8.	H314 / Skin corrosion/irritation Cat. 1	Causes severe skin burns and eye damage	4
9.	H317 / Skin sensitization Cat. 1	May cause an allergic skin reaction	2
10.	H332 / Acute toxicity (inhalation) Cat. 4	Harmful if inhaled	2
11.	H301 / Acute toxicity (oral) Cat. 3	Toxic if swallowed	1
12.	H334 / Respiratory sensitization Cat. 1	May cause allergy or asthma symptoms or breathing difficulties if inhaled	1
13.	H350 / Carcinogenicity Cat. 1	May cause cancer	1
14.	H371 / STOT-SE Cat. 2	May cause damage to organs	1
15.	H305 / Aspiration hazard Cat. 2	May be fatal if swallowed and enters airways	1

Table 4.3 below shows that acute toxicity oral Cat 4 had the highest number among the disinfectants which was n=25, then followed by serious eye damage/irritation Cat. 2A (n=23) and STOT-SE Cat. 3 (n=21). The least numbers of health hazard were acute toxicity (oral) Cat. 3, respiratory sensitisation Cat. 1, carcinogenicity Cat. 1, STOT-SE Cat. 2 and Aspiration hazard Cat 2 which were 1 respectively.

4.3 To Assess the Possible Routes of Exposure to Commercial Chemical Disinfectants.

Possible routes of exposure are the likelihood of exposure of person towards the CHTH through inhalation, dermal and oral/ingestion. Based on the CHRA method adopted for this study, there is 2 major routes of exposure which were inhalation and dermal. However, the oral/ingestion had not to be assessed in this study because there are few chemicals that will enter via this route.

From this study, 22 of these samples had inhalation exposure based on their H-code. The degree of CHTH release or presence (inhaled) in this study was moderate. This is due to criteria stated in the CHRA Manual which are:

1. Moderate release such as:
 - a) Solvents with medium drying time* in uncovered containers or exposed to the environment.
 - b) The detectable odour of chemicals
2. Medium volatility with the boiling point at 50°C to 150°C at room temperature.

The frequency of exposure and duration of exposure is required in order to determine the level of health risk of the chemical disinfectants. In this study, the

frequency of exposure was set as frequent because the exposure occurs one or more time per day. Meanwhile, the duration of exposure was rated as 1 because the exposure duration is less than 1 hour.

There are also 43 samples with dermal exposure have been identified in this study. The hazardous properties of the disinfectants included irritation (41), corrosive (6), acute toxicity (7), skin absorption (1), and other properties and sensitization (1).

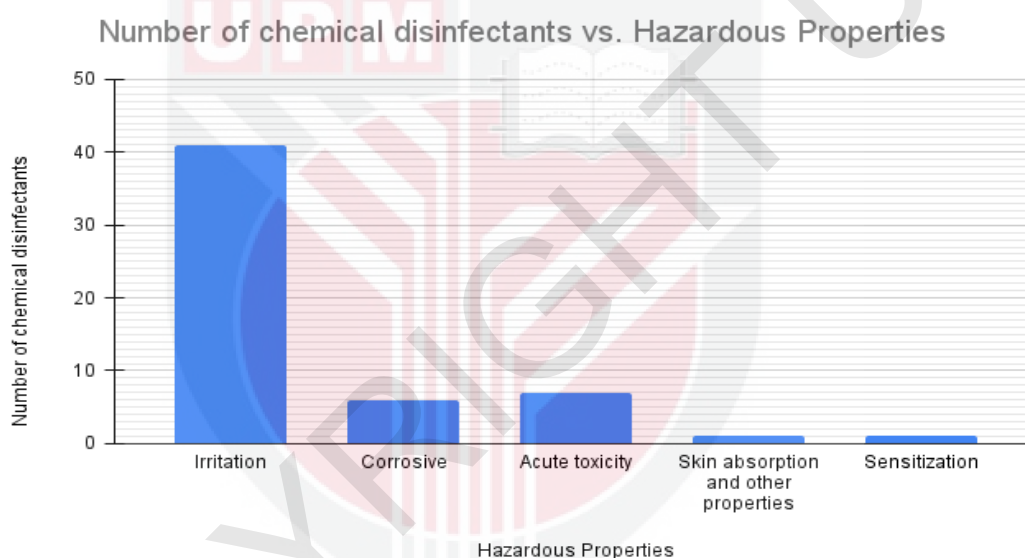


Figure 4.2: Hazardous Properties of Chemical Disinfectants via Dermal Contact

There are two factors to evaluate the degree of dermal exposure which extends of dermal contact and the duration of the contact. The extend of dermal contact for this study were small due to this condition:

1. Small are of contact with chemicals capable of skin absorption, skin sentizising or hazardous to the dermal e.g limited to palm (intact skin) (<2% or 0.04m²).
2. No indication of any skin condition; intact/normal skin
3. No contamination of skin or eyes

The duration of the dermal contact was assigned as long term which is the exposure of the disinfectants to humans is more than 15 minutes. This is because the disinfection activities usually take a longer time to complete (more than 15 minutes). According to CDC, the exposure of less than ten minutes exposure was not enough to disinfectants many objects, especially on the small and narrow surface. Table 4.4 below shows the comparison of exposure level between inhalation and dermal exposure for chemical disinfectants.

Table 4.4: Comparison of Exposure Level Between Inhalation and Dermal Exposure for Chemical Disinfectants

Exposure Level	Route of Exposure	
	Inhalation	Dermal Contact
Frequency of Exposure	FR = 5 (one or more time per day)	N/A
Duration of Exposure	DR = 1 (less than one hour)	N/A
Degree of chemical release	Moderate	N/A
Degree of chemical inhaled	Low	N/A
Extend of contact	N/A	Small
Duration of contact	N/A	Long term

As a conclusion, 31.9% of the samples had the inhalation exposure, 59.7% had the dermal exposure and 8.3% not possible to assess their exposure.

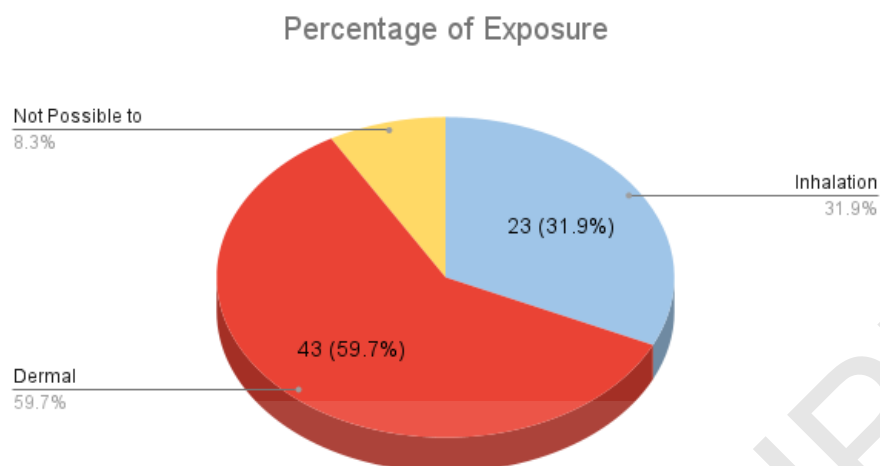


Figure 4.3: The Percentage of Route of Exposure based on the Chemical Disinfectant used for Disinfection Purpose

4.4 To Determine the Level of Health Risks Potentially Arising from the Usage of Commercial Chemical Disinfectants.

The health risk of the chemical disinfectants can be categorized into three-level which were low risk, moderate risk and high risk. For the inhalation exposure, the risk rating was being used in order to assign the level of health risk. The risk rating which rated from 1 to 25 indicate the likelihood of the illness. For the low risk, (RR= 1 to RR=4); moderate risk (RR= 5 to RR=12) and high risk (RR= 15 to RR=25).

From this study, 22 samples that had inhalation exposure. However, before determining the risk rating, are two factor would be considered which were hazard rating and exposure rating. The hazard rating for each of these samples range from 2 to 4, meanwhile the exposure rating same for the 22 samples which was 3. After determines the HR and ER, then table 3.16 (listed in Chapter 3) was used to assign the

level of health risk. Based on that table, the risk rating of inhalation exposure for these samples was fall under moderate level which rated from 5 to 12.

Table 4.5: Risk Estimation of Chemical Disinfectant via Inhalation Exposure

Hazard Rating (HR)	Exposure Rating	Risk Rating (Moderate)	Number of Disinfectants
2	3	6	12
3		9	7
4		12	3

Based on CHRA method, the risk for dermal exposure is rated from low level (L), moderate level (M1 &M2) and high risk (H1 & H2) based on risk matrix table. However, to determine the risk, the hazardous properties and duration/extent of skin contact were considered. As the result, 43 samples had dermal exposure. Among of them, 36 samples had moderate risk level (M2) and 7 samples had high risk level (H1=2; H2=5).

Number of Chemical Disinfectants vs. Risk Level for Dermal Exposure

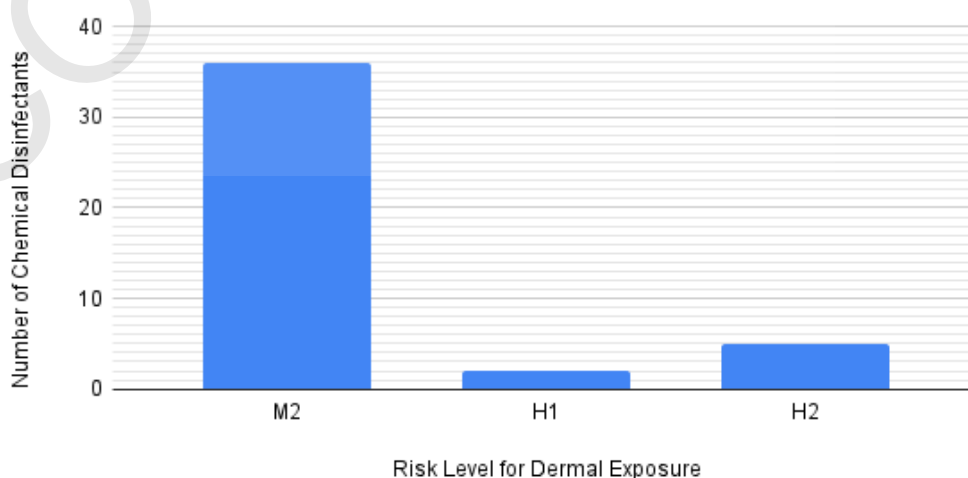


Figure 4.4: Risk Estimation of Chemical Disinfectant via Dermal Exposure

CHAPTER 5

DISCUSSION

There are eight (8) main types of active ingredients with different percent of concentration levels (%) contained in each of the disinfectants. The three most common active ingredients were isopropyl alcohol (n=14), ethanol (n=12), and benzalkonium chloride (n=10). Each of these active ingredients has its effectiveness to combat the covid-19 virus. According to Ghafoor et al., 2021, alcohol-based disinfectants (isopropyl alcohol and ethanol) have 70-90% of biocidal activity against coronavirus in 30 seconds. However, ethanol has a better record against hydrophilic viruses (Coronaviruses, Human Immunodeficiency Virus (HIV), and Rotavirus) compared to isopropyl alcohol (Ghafoor et al., 2021). On the other hand, benzalkonium chloride or known as alkyl dimethyl ammonium chloride is an organic salt that can be classified under quaternary ammonium compound (QAC). It is commonly used to combat coronavirus at concentration 1% or lower at an exposure duration of less than one minute. (Ghafoor et al., 2021). According to Ogilvie et al., 2021 benzalkonium chloride can inactivate coronavirus effectively. It is also listed as EPA's List N as the recommended disinfectant against Covid-19 virus (Ogilvie et al., 2021).

From this study, the five most hazard classifications for acute exposure found in the chemical disinfectants are "Harmful if Swallowed" (H302, n=25), "Causes serious eye irritation" (H319, n=23), "May cause drowsiness or dizziness" (H336, n=21), "cause eye irritation" (H320, n=18), and "Causes skin irritation" (H315, n=16). This indicated that overexposure to disinfectants whether via dermal contact, inhalation or ingestion can cause harmful effects to human health. However, the likelihood of exposure via ingestion had not been assessed in detail as followed by the methodology as suggested in CHRA Manual (CHRA Manual, 3rd ed, 2017). This study

also found that the number of disinfectants that had a dermal route of exposure is greater than inhalation exposure.

Among the common harmful health effect that may arise from the frequent usage of isopropyl alcohol-based chemical disinfectants was skin/eye irritation and cause drowsiness or dizziness. This is consistent with the findings found in past studies. In general, not only the effect of skin and eye irritation could range from acute to chronic effects that cause irritation, redness, and dryness (Ghafoor et al., 2021), the increased usage of chemical disinfectants has reported to increase the reported asthma cases during Covid-19 pandemic (Eldeirawi et al., 2021).

For the chronic exposure, the hazard classification contained in the chemical disinfectant was “May cause cancer” (H350, n=1). This hazard class was found in the samples that use isopropyl alcohol 75% as its active ingredients. According to International Agency for Research on Cancer (IARC, 1999), there was an increased case of paranasal sinuses cancer among employees at a factory that produces isopropyl alcohol by the strong-acid process. However, it is insufficient evidence of whether the cancer is caused by the isopropyl alcohol or diisopropyl sulfate which is an intermediate in the process (IARC, 1999). Conversely, the Health Jersey Department of Health reported that Isopropyl Alcohol was not classified as a substance that potentially can cause cancer (NJ Health, 2016). Therefore, the chronic carcinogenic effect that likely to cause by low-dose long-term exposure to alcohol-based chemical disinfectant is inconclusive in this context.

Considering the nature of the chemical hazard, and exposure pattern, this study also suggests that there is moderate risk via inhalation exposure and moderate to high risk via dermal exposure. Overall, seven disinfectants in this study were found to contain a high risk of dermal exposure to consumers. Two (2) of which are categorized

as “H1 risk” and five (5) of these chemical disinfectants are reported as “H2 risk” which indicated that it contains severe risk level than “H1” disinfectants via dermal contact. Comparatively, chemical disinfectant with “H1 dermal risk” contains hazards such as “Causes severe skin burns and eye damage” (H340) and “May cause cancer” (H350) as their hazard class. Based on the CHRA method, the consumer who exposes to these chemical disinfectants for more than 15 minutes is considered at the “H1” risk levels via dermal contact. Meanwhile, all the chemical disinfectants are also recorded with contains “H2” level of dermal risk level, especially with the hazards of “causes serious eye damage” (H318) for exposing to chemicals more than 15 minutes. It was suggested by the CDC where the rationale of disinfecting would more than 10 minutes to accomplish disinfection activities include small and narrow surfaces (CDC, 2020). The consumer is, therefore, suggest to equip themselves with appropriate dermal protection which includes both eye and skin while performing disinfection activities.

CHAPTER 6

CONCLUSION AND FUTURE RECOMMENDATION

In conclusion, alcohol based disinfectants such as isopropyl alcohol and ethanol are commonly used to against Covid-19 virus. They are also listed as EPA's List N as the recommended active ingredients contained in disinfectants to combat the virus. However, based on this study, most of the chemical disinfectants contains levels of chemical health risks to the consumers considering their route of exposure, and the frequency and duration of usage. This is because improper and excessive use of these disinfectants may result in harmful effects to the consumers such as skin and eyes irritation, skin sensitization, and skin allergies. Considering the nature of the health risks posed by chemical disinfectants, it is advised that disinfection activity be conducted only when it is necessary. This included, for example, if one of our family members in our house is sick or with confirms positive for Covid-19 disease has been in our house within the previous 24 hours or perform as routine disinfection but restricted to once daily is sufficient to eliminate the Covid-19 virus from the surfaces and help to ensure the facilities clean (CDC, 2020).

Consumers are also advised to take extra precautions when handling chemical disinfectants. They need to wear appropriate Personal Protective Equipment (PPE) such as rubber gloves and eyes protection to minimize the risk of chemical splashing (Ghafoor et al., 2021). Consumers are also advised to open windows and turn on exhaust fans so that the harmful vapor can be dispersed out (Toxics Use Reduction Institute, 2020). Consumers should also read and follow the direction on the label before use (CDC, 2020). It should be alerted that never mix the disinfectants because a hazardous reaction can occur when they mix. For example, the combination between

bleach and ammonia could release toxic gases which can be lethal (Toxics Use Reduction Institute, 2020).

Chemical Health Risk Assessment (CHRA) is one of the methods that has been used to determine the level of health risk arising from the frequent usage of those disinfectants. However, it is a preliminary method for estimating the health risks of chemical used based on the nature of chemicals and exposure background via semi quantitative assessment. This method very limited because it is only can be applied when there is enough information especially information regarding the concentration level of the ingredients (%), safety and health data, and toxicological information. Most of this information can be obtained from the Safety Data Sheet (SDS) and products' labels. So, consumers are advisable to at least obtain, one of these information to understand the background of the health hazards poses by the chemical disinfectant that used in their routine activity amidst the Covid-19 pandemic. However, for the purposes of detailed health risk assessment, a quantitative assessment using personal air sampling pump or area sampling pump shall be applied in order to quantify the health risks arising from the use of chemical disinfectants.

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APPENDICES

APPENDIX 1: Form B (List of Chemicals Hazardous to Health Assessed)

FORM B: LIST OF CHEMICALS HAZARDOUS TO HEALTH ASSESSED

WORK UNIT:

DATE OF ASSESSMENT:

Table B1: Chemicals Used in Work Unit

No.	Name of chemical	Hazardous ingredient	Physical form	Hazard classification	H-code	Source of information	HR	Dermal (Y/N)	Ingestion (Y/N)

Table B2: Chemicals Released by the Processes or Work Activities

No.	Name of chemical	Hazardous ingredient	Physical form	Hazard classification	H-code	Source of information	HR	Dermal (Y/N)	Ingestion (Y/N)

APPENDIX 2: Form C (Work Unit Assessment)

FORM C: WORK UNIT ASSESSMENT

WORK UNIT:

DATE OF ASSESSMENT:

Table C1: Inhalation Exposure Assessment

Job or task	Name of chemical	FR	DR	FDR	PEL	Degree of release or exposure level	Degree of chemical inhaled	MR	ER	HR	RR

Table C2: Dermal Assessment

Job or task	Name of chemical	Hazardous properties	Extent of dermal contact	Duration of exposure		Level of risk
				Short term (<15min/shift)	Long term (≥15min/shift)	

APPENDIX 3: Table 3.2 (The Baseline Information of Chemical Disinfectants)

No	Product Name	Manufacturer (Local/Import)	Price range (RM)	Type of shop purchased (pharmacies, drugstore, grocery)	SDS (Y/N)	Ingredients	Volume of product	Physical properties (gel, liquid)	Usage direction	Hazard statement	Pictogram	Hazard Unidentified	Source of Hazardous information
1		Local	12.16	Online	Y	Chlorhexidine, Benzalkonium Chloride	500 ml	Liquid	Spray this product 6-8 inches from surface and use a clean cloth to wipe until dry.	H302: Harmful if swallowed H315: Causes skin irritation H320: Causes eye irritation		N/A	SDS
2		Local	17.06	Online	N	Isopropyl alcohol (75%)	500 ml	Liquid	N/A	H319: Causes serious eye irritation H336: May cause drowsiness or dizziness		N/A	Pubchem
3		Import	55.55	Online	Y	Benzethonium Chloride (0.28%), Isopropyl alcohol (18.00%), Inert Ingredients (F-10%), Water (to 100%)	15cm x 17cm x 180pcs	Wipes	Pre-clean the surface to be disinfected to remove all gross debris. Dispose of pre-clean materials after decontamination. To disinfect in critical areas, use Clinicare Disinfectant Towelette to thoroughly wet the surface and allow to remain wet up to 3 minutes for broad spectrum activity at room (ambient) temperature. Leave to air dry or, if required wipe or	H302: Harmful if swallowed H315: Causes skin irritation H319: Causes serious eye irritation H336: May cause respiratory irritation	 	N/A	SDS
4		Local	31.14	Online	N	Denatured Alcohol Ethanol, Biocide	100 ml	Liquid	Spray lightly upwards into the air. To disinfect surfaces, spray directly and wipe dry	N/A	N/A	Hazard unidentified due to lack of information (ingredients composition)	N/A
5		Import	34.90	Online	Y	Eucalyptus Oil (25%), Hydrocarbon gases (>60), Ethanol (<15%)	200g	Gas	Shake can well. Hold can 15 - 20 cm from surface and spray until covered. Wipe if necessary	H301: Toxic if swallowed H315: Causes skin irritation H320: Causes eye irritation		N/A	SDS
6		Import	27.67	Online	Y	Alkyl Dimethyl benzyl ammonium chloride (0.32%)	180mm x 200mm x 75pcs	Wipes	Wipe surface to be disinfected. Use enough wipes to treated surfaces to remain visibly wet for 1-5 min. Let surface dry. For highly soiled surfaces, clean excess dirt first.	H302: Harmful if swallowed H315: Causes skin irritation H320: Causes eye irritation		N/A	SDS
7		Local	34.90	Online	N	Isopropyl alcohol (70%), Quaternary Ammonium Compound (<1%)	15cm x 21cm x 100pcs	Wipes	Use one sheet of wet wipes and wipe the surface which required disinfecting. For best result, use 2nd sheets on the same surface and make sure the surface remain wet for 5 to 10 mins. If the surface is soiled, wipe it clean with dry wipes or paper towel before disinfecting.	H315: Causes skin irritation H320: Causes eyes irritation H336: May cause drowsiness or dizziness		N/A	Label
8		Import	14.56	Online	Y	Propylene Glycol Butyl Ether (1-5%), Alcohol (1-5%), Benzalkonium Chloride (<1%)	750 ml	Liquid	N/A	H302: Harmful if swallowed H314: Causes severe skin burns and eye damage H315: Causes skin irritation H319: Causes serious eye irritation	 	N/A	SDS
9		Import	20.30	Online	N	Aqua, Benzethonium Chloride (0.07% -0.09%), Dimethylcone, Caproyl Methyl Glucamide	80 sheets	Wipes	For highly soiled surfaces, clean excess dirt first. Wipe surface to be disinfected, use enough wipes for treated surface to remain visibly wet for 2 min.	H319: Causes serious eye irritation		Hazard unidentified due to lack of information (chemical composition)	Label
10		Import	22.90	Online	Y	Ethanol (60-80%), Butane (F-10%), Propane (1-5%)	340g	Gas	Spray pre-cleaned surface 2 to 3 second until covered with mist. Allow to stand 10 minutes to air dry	H315: Causes skin irritation H320: Causes eye irritation H336: May cause respiratory irritation		N/A	SDS

11		Local	16.62	Online	N	Water (up to 99%), Benzalkonium chloride (0.5-1.0%), Peroxyacetic acid (0.015%), Non hazardous ingredients (<4%), Colouring (<0.05%)	500 ml	Liquid	N/A	H302: Harmful if swallowed. H312: Harmful in contact with skin. H315: Causes skin irritation. H319: Causes serious eye irritation		N/A	Label
12		Import	5.50	Online	N	Benzalkonium chloride (0.13%), Water, Glycerin, Aloe vera leaf, Alpha-tocopherol	150mm x 200mm x 10 pcs	Wipes	Open the lid, tear off the sticker and pull out the wipes for use. Please close in time after each use to avoid lotion volatilization.	H319: Causes serious eye irritation		N/A	Label
13		Import	6.61	Online	N	Medical alcohol (isopropyl alcohol (75%), RO purified water	13cm x 17cm x 10pcs	Wipes	N/A	H319: Causes serious eye irritation H336: May cause drowsiness or dizziness		N/A	Pubchem
14		Import	5.53	Drugstore	N	Water, Polyoxybate 20, benzalkonium Chloride, Glycerin, Melaleuca Alternifolia (Tea Tree) Leaf Oil, Fragrance, Tocopherol Acetate, Phenoxylethanol, Chlorphenesin, Potassium Sorbate	20pcs	Wipes	N/A	N/A	N/A	Hazard unidentified due to lack of information (chemical composition)	N/A
15		Local	23.90	Supermarket	N	Benzalkonium chloride (0.2%)	500ml	Liquid	Spray liberally, leaves for 30 seconds then wipe to spread evenly.	H302: Harmful if swallowed. H312: Harmful in contact with skin H315: Causes skin irritation H319: Causes serious eye irritation		N/A	Label
16		Import	13.00	Drugstore	N	Triethylene glycol, n-Alky Dimethyl Benzyl Ammonium Chloride, Ethanol, Water, Isobutane, Butane, Propane, Potassium phosphate, Potassium nitrite	280ml	Gas	Shake well before use. Spray pre-cleaned surface until wet. Allow product to remain on surface for 5 min.	N/A	N/A	Hazard unidentified due to lack of information (chemical composition)	N/A
17		Import	8.00	Drugstore	N	Ethanol (75%), Aqua	100ml	Liquid	Spray directly onto required surfaces.	H302: Harmful if swallowed H320: Causes eye irritation		N/A	Pubchem
18		Import	24.67	Online	N	Isopropyl Alcohol (<10%), Sodium Lauryl Sulfate (>2%), Citric Acid, GAG, Hydroxy Dichlor Diphenyl ethers (>1%), Water	500ml	Liquid	Spray and let stand for 5 minutes before wiping	H302: Harmful if swallowed H312: Harmful in contact with skin H315: Causes skin irritation H318: Causes serious eye damage H332: Harmful if inhaled H334: May cause allergy or asthma symptoms or breathing difficulties if inhaled	 	N/A	Label
19		Local	13.70	Online	N	Benzalkonium Chloride (50%), Perfume, Aqua, Exipients QS to 100%	480ml	Liquid	Turn nozzle to spray or stream position. Spray directly onto surface. Wipe over with clean damp cloth & allow to dry. No need to rinse.	H302: Harmful if swallowed H314: Causes severe skin burns and eye damage H318: Causes serious eye damage H335: May cause respiratory irritation	 	N/A	Label
20		Local	14.56	Online	Y	Water, Glycerin (<3%), Quaternary Ammonium Compounds (0.3%), Aloe Barbadosis Leaf Juice (<0.5%), Tocopherol Acetate (0.1%)	500ml	Liquid	Spray at targeted surface would like to disinfectant and wipe with clean dry cloth. Suitable to use to disinfectant food processing equipments or utensils with rinsing after disinfectant.	H302: Harmful if swallowed H320: Causes serious eye irritation		N/A	SDS

21		Import	22.67	Online	N	Aqua, Didecyl Dimethyl Ammonium Chloride, Benzalkonium Chloride, PEG-40 Hydrogenated Castor Oil, Fragrance	500ml	Liquid	Spray with a distance of 10-20cm away from surface. Spray the surface for 3 to 4 seconds until it is fully covered with mist. To disinfect, surfaces must remain wet for 2 minutes and above then allow to air dry. To sanitize, surfaces must remain wet for 10 seconds then allow to air dry.	N/A	N/A	Hazard unidentified due to lack of information (chemical composition)	N/A
22		Local	25.00	Online	N	Water (equat), Isopropyl alcohol (80%)	250ml	Liquid	Apply a small amount into palms of hands or surfaces.	H319: Causes serious eye irritation H336: May cause drowsiness or dizziness		N/A	Pubchem
23		Import	18.90	Online	N	Isopropyl alcohol (80%), Aqua, Benzalkonium chloride, Chlorhexidine digluconate	500ml	Liquid	Spray to desired surface and allow to wipe or air dry	H319: Causes serious eye irritation H336: May cause drowsiness or dizziness		N/A	Pubchem
24		Local	20.20	Online	N	Propan-2-ol, Docusate sodium, 2-phenylphenol, chloroxesol	500ml	Liquid	Spray evenly to the areas, equipment, furniture that need to be sanitized. You may brush accordingly if needed. Leave it 20 minutes for the sanitizing process. Then rinse with water or wipe with damp cloth.	N/A	N/A	Hazard unidentified due to lack of information (chemical composition)	N/A
25		Import	30.22	Online	N	Didecyl Dimethyl Ammonium Chloride (0.55%), Benzalkonium Chloride (0.45%)	450ml	Liquid	Spray our solution over the surface you are cleaning from a distance of 15-20cm and continue until you have coated the surface evenly. Leave the WIZACT 24™ solution to dry for at least 60 seconds. Once the surface is dry, WIZACT 24™ has been applied correctly.	H302: Harmful if swallowed. H312: Harmful in contact with skin H315: Causes skin irritation H319: Causes serious eye irritation		N/A	Label
26		Local	9.52	Online	N	Propanol (65%), Ethanol (12%), Hydrogen Peroxide (40.5%)	60ml	Liquid	For hard surfaces, apply the required amount and allow 30 seconds for solution to disinfect surface before wiping off with a dry cloth or towel.	H302: Harmful if swallowed H319: Causes serious eye damage H320: Causes eye irritation H336: May cause drowsiness or dizziness	 	N/A	Pubchem
27		Local	8.77	Online	Y	Isopropyl Alcohol (30-60%), Ethanol (30-60%)	50ml	Liquid	N/A	H302: Harmful if swallowed H305: May be fatal if swallowed and enters airways H320: Causes eye irritation H335: May cause respiratory irritation H336: May cause drowsiness or dizziness H371: May cause damage to organs		N/A	SDS
28		Local	15.00	Online	Y	Water (>90%), Hypochlorous acid (0.015%)	100ml	Liquid	Turn the spray cap ON. Shake lightly and spray with 20cm distance for 3-5 times from the object. Dry the object well after spraying. Clean the application site if required. Turn the spray cap OFF after use. Repeat as needed throughout the day. Use it for your daily regimen. No rinsing required.	H302: Harmful if swallowed		N/A	SDS
29		Local	20	Online	Y	Isopropyl alcohol (75%)	400ml	Gas	Spray evenly on targeted surface. Leave it for 3 minutes, then wipe with clean paper towel or cloth.	H302: Harmful if swallowed H312: Harmful in contact with skin H315: Causes skin irritation H319: Causes serious eye irritation H332: Harmful if inhaled H335: May cause respiratory irritation H336: May cause drowsiness or dizziness H350: May cause cancer		N/A	SDS
30		Import	17.76	Drugstore	Y	Ethanol (60%), Hydrocarbon propellant (15-30%)	450g	Gas	Shake can well. Hold can 15-20cm from pre-cleaned surface and spray surface until covered with mist. Do not saturate fabric when using on soft surface. Allow to air dry. No need to wipe. Surfaces may vary in quality. Always test for suitability on a small inconspicuous area prior to use. Do not use on polished wood, painted surfaces or acrylic plastics.	H320: Causes eye irritation H335: May cause respiratory irritation		N/A	SDS

31		Import	9.89	Supermarket	Y	Sodium Dodecyl Benzene Sulphonate (1-9%)	2 litre	Liquid	For stubborn stain and disinfecting, pour directly onto the surface or on a damp cloth. Leaves for 5 minutes before wiping off	H312: Harmful in contact with skin H315: Causes skin irritation H317: May cause an allergic skin reaction H330: Causes eye irritation H335: May cause respiratory irritation		N/A	SDB
32		Import	6.59	Supermarket	Y	<5% Non-ionic surfactant, Benzalkonium chloride (0.01 - <1%), Perfume, Amyl Cinnamal, Methylchloroisobiazolinone, Methylisothiazolinone	750ml	Liquid	Turn the spray nozzle to the ON position. Spray from 30cm. For disinfection, leaves for 5 minutes. Wipe with a clean cloth. Use only in a well-ventilated area. Direct spray away from face. Safe for use with septic tanks. After use, return the spray nozzle to the OFF position	H314: Causes severe skin burns and eye damage H302: Harmful if swallowed H318: Causes serious eye damage	 	N/A	SDB
33		Local	24.90	Pharmacy	Y	Isopropyl alcohol (75%), Alcohol Denat, Water, Glycerin, Aloe Barbardensis Leaf Juice, Orange Oil Extract, Tocopheryl Acetate	500ml	Liquid	Spray at the target surface would like to disinfectant and leave dry or wipe with clean cloth	H319: Causes serious eye irritation H336: May cause drowsiness or dizziness		N/A	Pubchem
34		Local	15.90	Pharmacy	N	Ethanol (60%), Butane, Propane, Alcohol Denat, Triethylen Glycol (TEG), Quarternary Ammonium Compound, Fragrance	300ml	Gas	Shake well before use. Hold the canister upwards and press the actuator to release the content. For Surface Disinfectant, spray target area for 2-3 seconds with use on polished wood, painted surfaces, leather, rayon fabrics or acrylic plastics	H302: Harmful if swallowed H330: Causes eye irritation		N/A	Pubchem
35		Local	10.08	Supermarket	N	Aqua, Denaturated Ethyl Alcohol, Decyl Glucoside, Cocamide DEA, Pareth-23, Xanthan Gum, Fragrance, Cellulose, Sodium Metasilicate, Sodium Cocamidopropylate, Glycerin, Lauryl Glucoside, Sodium Cocoyl Glutamate, Sodium Lauryl Glucose Carboxylate, Coco-Glucoside, Extracts of Aloe vera & Camellia sinensis	500ml	Liquid	Shake well before use. Turn the nozzle to spray or stream and spray from 20-25cm away. Wipe clean with a soft dry cloth. No rinsing required.	N/A	N/A	Hazard unidentified due to lack of information (chemical composition)	N/A
36		Local	29.9	Supermarket	N	Isopropyl Alcohol (70%), Deionized water	50 sheets	Wipes	1. Locate tear-notch on the side of sachet. 2. Pull the Wipes out through opening 3. Wipes the areas as required 4. Dispose off wipes/sachet in dustbin. Do not flush into toilet	H319: Causes serious eye irritation H336: May cause drowsiness or dizziness		N/A	Pubchem
37		Import	5.00	Pharmacy	N	Chloroxylenol (4.8%)	50ml	Liquid	1) Wash cloth: 7 full cup + 1 litre water 2) Floor and hard surface: 7 full cup + 1 litre water 3) Toilet, sink and drain: Do not add water	H315: Causes skin irritation H330: Causes eye irritation H335: May cause respiratory irritation		N/A	Pubchem
38		Local	10.90	Supermarket	Y	Benzalkonium Chloride (0.3%), Genamino (3%), Aqua (96.7%)	60ml	Liquid	Apply full strength with trigger sprayed to completely wet all surfaces. Let stay 3 minutes, then wipe. For heavily soiled area, a pre-cleaning is required. Do not apply on dishes or utensils. For food contact surfaces such as institutional kitchen/restaurant counters, tables and appliances, rinse disinfected surface with portable water.	H319: Causes serious eye irritation		N/A	SDB
39		Local	5.99	Supermarket	N	Dimethyl Benzyl Ammonium Chloride (60%), Dimethyl Ethylbenzyl Ammonium Chloride (68%)	307g	Wipes	Open front resealable sticker and pull out wipes. Reseal after use to prevent product from drying out. Use to disinfect/insectize hard, non porous surfaces. Test a small area first before use.	H315: Causes skin irritation H319: Causes serious eye irritation		N/A	Pubchem
40		Import	15.80	Pharmacy	N	Ethanol (44.1%), Eucalyptus Oil (13.6%), Melaleuca Oil (1.6%), Lavender Oil (0.9%)	55ml	Liquid	For children and adult, spray directly (about inches) onto affected area 3 to 4 times daily until the minor cuts heal & there is no itching for insect bites	H302: Harmful if swallowed H330: Causes eye irritation		N/A	Pubchem

41		Local	3.80	Pharmacy	N	Aqua, Isopropyl Alcohol (70%)	15 x 20cm x 10 sheets	Wipes	N/A	H319: Causes serious eye irritation H336: May cause drowsiness or dizziness		N/A	Pubchem
42		Local	4.90	Pharmacy	N	Alcohol denat, Isopropyl Alcohol (75%), Water, Glycerin, Aloe Barbadensis Leaf Juice, Tocopheryl Acetate	50ml	Liquid	Spray at the target surface would like to disinfectant and leave dry or wipe with clean cloth	H319: Causes serious eye irritation H336: May cause drowsiness or dizziness		N/A	Pubchem
43		Local	19.90	Pharmacy	N	Alcohol Denatured Ethanol (75%), Liquefied Petroleum Gas, Quaternary Ammonium Compound, Citronella (Cymbopogon Nardus) Essential Oil, Tea Tree Essential Oil (Melaleuca Alternifolia Oil)	420ml	Gas	Spray at the target surface would like to disinfectant and leave dry or wipe with clean cloth. Shake before use.	H302: Harmful if swallowed H320: Causes eye irritation		N/A	Pubchem
44		Import	28.90	Pharmacy	Y	Benzalkonium chloride (0.310%), Diocetyltrimethylammoniumchloride (0.940%), Polyhexamethylenebiguanide poly Hydrochloride (0.866%), Propan-2-ol (1-2%), Alcoholethoxyrate (1-2%)	120pcs	Wipes	To clean: Wipe surface until all visible soiling is removed. To disinfect: Wipe surface ensuring it remains wet for 1 minutes	H302: Harmful if swallowed. H312: Harmful in contact with skin. H314: Causes severe skin burns and eye damage. H315: Causes skin irritation. H317: May cause an allergic skin reaction H318: Causes serious eye damage. H319: Causes serious eye irritation H336: May cause drowsiness or dizziness	 	N/A	SDS
45		Local	6.80	Pharmacy	N	Isopropyl Alcohol (70%)	60ml	Liquid	To sanitize surface: Apply a small amount on surface, wait 30 seconds then wipe with an paper towel or cloth. Avoid use on varnished, polished or lacquered surfaces. If in doubt, test on a small area.	H319: Causes serious eye irritation H336: May cause drowsiness or dizziness		N/A	Pubchem
46		Local	26.00	Pharmacy	N	Alcohol (70%) Aqua, Glycerin, Orange Oil	60ml	Liquid	Spray on the surface you would like to sanitize	H302: Harmful if swallowed H320: Causes eye irritation		N/A	Pubchem
47		Local	10.95	Online	Y	Isopropyl alcohol (60-80%), Water (10-30%), Cucumber seed extract (1-5%)	100ml	Liquid	Just spray onto surface and wipe off where necessary. No rinse required.	H319: Cause serious eye irritation H336: May cause drowsiness and dizziness		N/A	SDS
48		Local	25	Online	Y	Denatured Ethyl Alcohol (75%), Aqua (19.70%), Propylene Glycol (4%), Glycerine (1%), Tocopheryl Acetate (0.1%), Fragrance (0.2%)	1litre	Liquid	Spray on surface. Wait 30 seconds. Avoid use on varnished, polished or lacquered surfaces	H302: Harmful if swallowed H319: Cause serious eye irritation		N/A	SDS
49		Local	15.9	Online	N	Denatured Alcohol Ethanol (70%), Perfume and Water	500ml	Liquid	Turn nozzle to ON position. Simply spray directly to surface. Wipe over with clean damp cloth & allow to dry. For electric equals spray on the cloth before wiping.	H302: Harmful if swallowed H320: Causes eye irritation		N/A	Pubchem
50		Import	15.46	Online	N	Ethyl Alcohol (75%), Propane, Butane, Isobutane	150ml	Gas	Shake can well. Hold can 15-20cm from pre-cleaned surface and spray for 2-3 seconds. Let stand for 10 minutes	H302: Harmful if swallowed H320: Causes eye irritation		N/A	Pubchem

No	Product Name	Hazardous Ingredients	HAZARD STATEMENTS/H-CODE	Acute toxicity (oral)			Acute toxicity (dermal)			Acute toxicity (inhalation)			Skin corrosion/irritation	Serious eye damage/irritation	Respiratory sensitisation	Skin Sensitisation	Germ cell mutagenicity	Carcinogenicity		STOT-SE			STOT-RE		Aspiration hazard	
				Cat1	Cat2	Cat3	Cat 4	Cat1	Cat2	Cat3	Cat4	Cat1	Cat2	Cat3	Cat4	Cat1	Cat2	Cat1	Cat2	Cat1	Cat2	Cat1	Cat2	Cat1	Cat2	Cat1
11		Benzalkonium chloride (0.5-1.0%), Peroxyacetic acid (0.015%)	H302: Harmful if swallowed. H312: Harmful in contact with skin. H315: Causes skin irritation. H319: Causes serious eye irritation	/			/					/		A												
12		Benzalkonium chloride (0.13%)	H319: Causes serious eye irritation												A											
13		Medical alcohol Isopropyl alcohol (75%)	H319: Causes serious eye irritation H336: May cause drowsiness or dizziness											A							/					
14		Water, Polysorbate 20, benzalkonium Chloride, Glycerin, Melaleuca Alternifolia (Tea Tree) Leaf Oil, Fragrance, Tocopheryl Acetate, Phenoxyethanol, Chlorphenesin, Potassium Sorbate	N/A																							
15		Benzalkonium chloride (0.2%)	H302: Harmful if swallowed. H312: Harmful in contact with skin H315: Causes skin irritation H319: Causes serious eye irritation	/			/					/		A												
16		Triethylene glycol, n-Alkyl Dimethyl Benzyl Ammonium Chloride, Ethanol, Water, Isobutane, Butane, Propane, Potassium phosphate, Potassium nitrite	N/A																							
17		Ethanol (75%)	H302: Harmful if swallowed H320: Causes eye irritation	/											B											
18		Isopropyl Alcohol (<10%), Sodium Lauryl Sulphate (>2%)	H302: Harmful if swallowed H312: Harmful in contact with skin H315: Causes skin irritation H318: Causes serious eye damage H319: Causes serious eye irritation H332: Harmful if inhaled H334: May cause allergy or asthma symptoms or breathing difficulties if inhaled	/			/			/	/	/	/	A	/											
19		Benzalkonium Chloride (50%)	H302: Harmful if swallowed H314: Causes severe skin burns and eye damage H318: Causes serious eye damage H335: May cause respiratory irritation	/								/	/								/					
20		Water, Glycerin (<3%), Quaternary Ammonium Compounds (0.9%)	H302: Harmful if swallowed H320: Causes serious eye irritation	/											B											

No	Product Name	Hazardous Ingredients	HAZARD STATEMENTS/H-CODE	Acute toxicity (oral)		Acute toxicity (dermal)		Acute toxicity (inhalation)		Skin corrosion/irritation		Serious eye damage/irritation		Respiratory sensitisation	Skin Sensitation		Germ cell mutagenicity		Carcinogenicity		STOT-SE		STOT-RE		Aspiration hazard		
				Ch.1	Ch.2	Ch.3	Ch.4	Ch.1	Ch.2	Ch.3	Ch.4	Ch.1	Ch.2	Ch.1	Ch.2	Ch.1	Ch.2	Ch.1	Ch.2	Ch.1	Ch.2	Ch.1	Ch.2	Ch.1	Ch.2	Ch.1	Ch.2
21		Aqua, Didecyl Dimethyl Ammonium Chloride, Benzalkonium Chloride, PEG-40 Hydrogenated Castor Oil, Fragrance	N/A																								
22		Isopropyl alcohol (80%)	H319: Causes serious eye irritation H336: May cause drowsiness or dizziness										A									/					
23		Isopropyl alcohol (80%), Benzalkonium chloride, Chlorhexidine digluconate	H319: Causes serious eye irritation H336: May cause drowsiness or dizziness										A									/					
24		Propan-2-ol, Docusate sodium, 2-phenylphenol, chlorocresol	N/A																								
25		Didecyl Dimethyl Ammonium Chloride (0.55%), Benzalkonium Chloride (0.45%)	H302: Harmful if swallowed. H312: Harmful in contact with skin H315: Causes skin irritation H319: Causes serious eye irritation	/									A														
26		Propanol (65%), Ethanol (12%), Hydrogen Peroxide (<0.5%)	H302: Harmful if swallowed H318: Causes serious eye damage H320: Causes eye irritation H336: May cause drowsiness or dizziness	/									B									/					
27		Isopropyl Alcohol (30-60%), Ethanol (30-60%)	H302: Harmful if swallowed H305: May be fatal if swallowed and enters airways H320: Causes eye irritation H335: May cause respiratory irritation H336: May cause drowsiness or dizziness H371: May cause damage to organs	/									B									/	/				/
28		Hypochlorous acid (0.015%)	H302: Harmful if swallowed	/																							
29		Isopropyl alcohol (75%)	H302: Harmful if swallowed H312: Harmful in contact with skin H315: Causes skin irritation H319: Causes serious eye irritation H320: Causes eye irritation H335: May cause respiratory irritation H336: May cause drowsiness and dizziness H350: May cause cancer	/		/		/	/	/			A									/					
30		Ethanol (60%), Hydrocarbon propellant (10-30%)	H320: Causes eye irritation H335: May cause respiratory irritation										B									/					

No	Product Name	Hazardous Ingredients	HAZARD STATEMENTS/SH-CODE	Acute toxicity (oral)				Acute toxicity (dermal)				Acute toxicity (inhalation)				Skin corrosion/irritation		Serious eye damage/irritation		Respiratory sensitisation		Skin Sensitation		Germ cell mutagenicity		Carcinogenicity		STOT-SE		STOT-RE		Aspiration hazard	
				Cat1	Cat2	Cat3	Cat4	Cat1	Cat2	Cat3	Cat4	Cat1	Cat2	Cat3	Cat4	Cat1	Cat2	Cat1	Cat2	Cat1	Cat2	Cat1	Cat2	Cat1	Cat2	Cat1	Cat2	Cat1	Cat2	Cat1	Cat2		
31		Sodium Dodecyl Benzene Sulphonate (1-5%)	H302: Harmful if swallowed H312: Harmful in contact with skin H315: Causes skin irritation H317: May cause an allergic skin reaction H320: Causes eye irritation H335: May cause respiratory irritation	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/			
32		<5% Non-ionic surfactant, Benzalkonium chloride (0.01 - <1%)	H302: Harmful if swallowed H314: Causes severe skin burns and eye damage H318: Causes serious eye damage	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/				
33		Isopropyl alcohol (75%), Alcohol Denat	H319: Causes serious eye irritation H336: May cause drowsiness or dizziness	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/				
34		Ethanol (80%), Butane, Propane, Alcohol Denat, Trietheln Glycol (TEG), Quarternary Ammonium Compound,	H302: Harmful if swallowed H320: Causes eye irritation	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/				
35		Aqua, Denatured Ethyl Alcohol, Decyl Glucoside, Cocamide DEA, Pareth-25, Xanthan Gum, Fragrance, Cellulose, Sodium Metasilicate, Sodium Cocamphoacetate, Glycerin, Lauryl Glucoside, Sodium Cocoyl Glutamate, Sodium Lauryl Glucose Carboxylate, Coco-Glucoside, Extracts of Aloe vera & Camellia sinensis	N/A	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/				
36		Isopropyl Alcohol (70%)	H319: Causes serious eye irritation H336: May cause drowsiness or dizziness	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/				
37		Chloroxyleneol (4.8%)	H315: Causes skin irritation H320: Causes eye irritation H335: May cause respiratory irritation	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/				
38		Benzalkonium Chloride (0.3%), Genamino (3%), Aqua (96.7%)	H319: Causes serious eye irritation	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/				
39		Dimethyl Benzyl Ammonium Chloride (80%), Dimethyl Ethylbenzyl Ammonium Chloride (8%)	H315: Causes skin irritation H319: Causes serious eye irritation	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/				
40		Ethanol (44.1%), Eucalyptus Oil (13.6%), Melaleuca Oil (1.8%), Lavender Oil (0.9%)	H302: Harmful if swallowed H320: Causes eye irritation	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/				

APPENDIX 5: Table 3.3 (Hazard Rating of Chemical Disinfectants)

No	Product Name	Hazardous ingredients	Hazardous classification	H-code	Source of information	Hazard Rating (HR)	Dermal (Y/N)	Ingestion (Y/N)
1		Benzalkonium Chloride	1) Acute toxicity (oral) Cat. 4 2) Skin corrosion/irritation Cat. 2 3) Serious eye damage/eye irritation Cat 2B	H302: Harmful if swallowed H315: Causes skin irritation H320: Causes eye irritation	SDS	N/A	Y	Y
2		Isopropyl alcohol (75%)	1) Serious eye damage/eye irritatio Cat. 2A 2) Specific target organ toxicity, single exposure Cat. 3	H319: Causes serious eye irritation H338: May cause drowsiness or dizziness	Pubchem	2	Y	N
3		Isopropyl alcohol (18.00%)	1) Acute toxicity (oral) Cat. 4 2) Skin corrosion/irritation Cat. 2 3) Serious eye damage/eye irritation Cat. 2A 4) Specific target organ toxicity, single exposure Cat. 3	H302: Harmful if swallowed H315: Causes skin irritation H319: Causes serious eye irritation H335: May cause respiratory irritation	SDS	3	Y	Y
4		Denatured Alcohol Ethanol, Biocide	N/A	N/A	N/A	N/A	N	N
5		Ethanol (<15%)	1) Acute toxicity (oral) Cat. 3 2) Skin corrosion/irritation Cat. 2 3) Serious eye damage/eye irritation Cat 2B	H301: Toxic if swallowed H315: Causes skin irritation H320: Causes eye irritation	SDS	N/A	Y	Y
6		Alkyl Dimethyl benzyl ammonium chloride (0.32%)	1) Acute toxicity (oral) Cat. 4 2) Skin corrosion/irritation Cat. 2 3) Serious eye damage/eye irritation Cat 2B	H302: Harmful if swallowed H315: Causes skin irritation H320: Causes eye irritation	SDS	N/A	Y	Y
7		Isopropyl alcohol (70%)	1) Skin corrosion/irritation Cat. 2 2) Serious eye damage/eye irritation Cat 2B 3) Specific target organ toxicity, single exposure Cat. 3	H315: Causes skin irritation H320: Causes eyes irritation H338: May cause drowsiness or dizziness	Label	2	Y	N
8		Alcohol (1-5%), Benzalkonium Chloride (<1%)	1) Acute toxicity (oral) Cat. 4 2) Skin corrosion/irritation Cat. 1 3) Skin corrosion/irritation Cat. 2 4) Serious eye damage/eye irritation Cat. 2A	H302: Harmful if swallowed H314: Causes severe skin burns and eye damage H315: Causes skin irritation H319: Causes serious eye irritation	SDS	N/A	Y	Y
9		Benzethonium Chloride (0.07% -0.09%)	1) Serious eye damage/eye irritation Cat. 2A	H319: Causes serious eye irritation	Label	N/A	Y	N
10		Ethanol (60-80%)	1) Skin corrosion/irritation Cat. 2 2) Serious eye damage/eye irritation Cat 2B 3) Specific target organ toxicity, single exposure Cat. 3	H315: Causes skin irritation H320: Causes eye irritation H335: May cause respiratory irritation	SDS	3	Y	N

No	Product Name	Hazardous Ingredients	Hazardous classification	H-code	Source of information	Hazard Rating (HR)	Dermal (Y/N)	Ingestion (Y/N)
11		Benzalkonium chloride (0.5-1.0%)	1) Acute toxicity (oral) Cat. 4 2) Acute toxicity, (dermal) Cat. 4 3) Skin corrosion/irritation Cat. 2 4) Serious eye damage/eye irritation Cat. 2A	H302: Harmful if swallowed. H312: Harmful in contact with skin. H315: Causes skin irritation. H319: Causes serious eye irritation	Label	N/A	Y	Y
12		Benzalkonium chloride (0.13%)	1) Serious eye damage/eye irritation Cat. 2A	H319: Causes serious eye irritation	Label	N/A	Y	N
13		Medical alcohol isopropyl alcohol (75%)	1) Serious eye damage/eye irritation Cat. 2A 2) Specific target organ toxicity, single exposure Cat. 3	H319: Causes serious eye irritation H336: May cause drowsiness or dizziness	Pubchem	2	Y	N
14		Benzalkonium Chloride	N/A	N/A	N/A	N/A	N	N
15		Benzalkonium chloride (0.2%)	1) Acute toxicity (oral) Cat. 4 2) Acute toxicity, (dermal) Cat. 4 3) Skin corrosion/irritation Cat. 2 4) Serious eye damage/eye irritation Cat. 2A	H302: Harmful if swallowed. H312: Harmful in contact with skin H315: Causes skin irritation H319: Causes serious eye irritation	Label	N/A	Y	Y
16		n-Alkyl Dimethyl Benzyl Ammonium Chloride, Ethanol	N/A	N/A	N/A	N/A	N	N
17		Ethanol (75%)	1) Acute toxicity (oral) Cat. 4 2) Serious eye damage/eye irritation Cat. 2B	H302: Harmful if swallowed H320: Causes eye irritation	Pubchem	N/A	Y	Y
18		Isopropyl Alcohol (~10%)	1) Acute toxicity (oral) Cat. 4 2) Acute toxicity, (dermal) Cat. 4 3) Skin corrosion/irritation Cat. 2 4) Serious eye damage/eye irritation Cat. 1 5) Serious eye damage/eye irritation Cat. 2A 6) Acute toxicity (inhalation) Cat. 4 7) Sensitization Cat. 1	H302: Harmful if swallowed H312: Harmful in contact with skin H315: Causes skin irritation H318: Causes serious eye damage H319: Causes serious eye irritation H332: Harmful if inhaled H334: May cause allergy or asthma symptoms or breathing difficulties if inhaled	Label	4	Y	Y
19		Benzalkonium Chloride (50%)	1) Acute toxicity (oral) Cat. 4 2) Skin corrosion/irritation Cat. 1 3) Serious eye damage/eye irritation Cat. 1 4) Specific target organ toxicity, single exposure Cat. 3	H302: Harmful if swallowed H314: Causes severe skin burns and eye damage H318: Causes serious eye damage H335: May cause respiratory irritation	Label	3	Y	Y
20		Quaternary Ammonium Compounds (0.3%)	1) Acute toxicity (oral) Cat. 4 2) Serious eye damage/eye irritation Cat. 2B	H302: Harmful if swallowed H320: Causes serious eye irritation	SDS	N/A	Y	Y

No	Product Name	Hazardous Ingredients	Hazardous classification	H-code	Source of information	Hazard Rating (HR)	Dermal (Y/N)	Ingestion (Y/N)
21		Didecyl Dimethyl Ammonium Chloride, Benzalkonium Chloride	N/A	N/A	N/A	N/A	N	N
22		Isopropyl alcohol (80%)	1) Serious eye damage/eye irritation Cat. 2A 2) Specific target organ toxicity, single exposure Cat. 3	H319: Causes serious eye irritation H336: May cause drowsiness or dizziness	Pubchem	2	Y	N
23		Isopropyl alcohol (80%)	1) Serious eye damage/eye irritation Cat. 2A 2) Specific target organ toxicity, single exposure Cat. 3	H319: Causes serious eye irritation H336: May cause drowsiness or dizziness	Pubchem	2	Y	N
24		Propan-2-ol	N/A	N/A	N/A	N/A	N	N
25		Didecyl Dimethyl Ammonium Chloride (0.55%), Benzalkonium Chloride (0.45%)	1) Acute toxicity (oral) Cat. 4 2) Acute toxicity, (dermal) Cat. 4 3) Skin corrosion/irritation Cat. 2 4) Serious eye damage/eye irritation Cat. 2A	H302: Harmful if swallowed. H312: Harmful in contact with skin H315: Causes skin irritation H319: Causes serious eye irritation	Label	N/A	Y	Y
26		Propanol (65%), Ethanol (12%)	1) Acute toxicity (oral) Cat. 4 2) Serious eye damage/eye irritation Cat. 1 3) Serious eye damage/eye irritation Cat. 2B 4) Specific target organ toxicity, single exposure Cat. 3	H302: Harmful if swallowed H318: Causes serious eye damage H320: Causes eye irritation H336: May cause drowsiness or dizziness	Pubchem	2	Y	Y
27		Isopropyl Alcohol (30-50%), Ethanol (30-50%)	1) Acute toxicity (oral) Cat. 4 2) Aspiration hazard Cat. 2 3) Serious eye damage/eye irritation Cat. 2B 4) Specific target organ toxicity, single exposure Cat. 3 5) Specific target organ toxicity, single exposure Cat. 3 6) Specific target organ toxicity, single exposure Cat. 2	H302: Harmful if swallowed H305: May be fatal if swallowed and enters always H320: Causes eye irritation H335: May cause respiratory irritation H336: May cause drowsiness or dizziness H371: May cause damage to organs	SDS	4	Y	Y
28		Hypochlorous acid (0.015%)	1) Acute toxicity (oral) Cat. 4	H302: Harmful if swallowed	SDS	N/A	N	Y
29		Isopropyl alcohol (75%)	1) Acute toxicity (oral) Cat. 4 2) Acute toxicity, (dermal) Cat. 4 3) Skin corrosion/irritation Cat. 2 4) Serious eye damage/eye irritation Cat. 2A 5) Acute toxicity (inhalation) Cat. 4 6) Specific target organ toxicity, single exposure Cat. 3 7) Specific target organ toxicity, single exposure Cat. 3 8) Carcinogenicity Cat. 1	H302: Harmful if swallowed H312: Harmful in contact with skin H315: Causes skin irritation H319: Cause serious eye irritation H332: Harmful if inhaled H335: May cause respiratory irritation H336: May cause drowsiness and dizziness H350: May cause cancer	SDS	4	Y	Y
30		Ethanol (60%)	1) Serious eye damage/eye irritation Cat. 2B 2) Specific target organ toxicity, single exposure Cat. 3	H320: Causes eye irritation H335: May cause respiratory irritation	SDS	3	Y	N

No	Product Name	Hazardous Ingredients	Hazardous classification	H-code	Source of Information	Hazard Rating (HR)	Dermal (Y/N)	Ingestion (Y/N)
31		Sodium Dodecyl Benzene Sulphonate (1-5%)	1) Acute toxicity (oral) Cat. 4 2) Acute toxicity, (dermal) Cat. 4 3) Skin corrosion/irritation Cat. 2 4) Sensitization, Skin Cat. 1 5) Serious eye damage/eye irritation Cat. 2B 6) Specific target organ toxicity, single exposure Cat. 3	H302: Harmful if swallow H312: Harmful in contact with skin H315: Causes skin irritation H317: May cause an allergic skin reaction H320: Causes eye irritation H335: May cause respiratory irritation	SDS	3	Y	Y
32		Benzalkonium chloride (0.01 - <1%)	1) Acute toxicity (oral) Cat. 4 2) Skin corrosion/irritation Cat. 1 3) Serious eye damage/eye irritation Cat. 1	H302: Harmful if swallow H314: Causes severe skin burns and eye damage H318: Causes serious eye damage	SDS	N/A	Y	Y
33		Isopropyl alcohol (75%)	1) Serious eye damage/eye irritation Cat. 2A 2) Specific target organ toxicity, single exposure Cat. 3	H319: Causes serious eye irritation H336: May cause drowsiness or dizziness	Pubchem	2	Y	N
34		Ethanol (60%)	1) Acute toxicity (oral) Cat. 4 2) Serious eye damage/eye irritation Cat. 2B	H302: Harmful if swallowed H320: Causes eye irritation	Pubchem	N/A	Y	Y
35		Denatured Ethyl Alcohol	N/A	N/A	N/A	N/A	N	N
36		Isopropyl Alcohol (70%)	1) Serious eye damage/eye irritation Cat. 2A 2) Specific target organ toxicity, single exposure Cat. 3	H319: Causes serious eye irritation H336: May cause drowsiness or dizziness	Pubchem	2	Y	N
37		Chloroxylenol (4.8%)	1) Skin corrosion/irritation Cat. 2 2) Serious eye damage/eye irritation Cat. 2B 3) Specific target organ toxicity, single exposure Cat. 3	H315: Causes skin irritation H320: Causes eye irritation H335: May cause respiratory irritation	Pubchem	3	Y	N
38		Benzalkonium Chloride (0.3%)	1) Serious eye damage/eye irritation Cat. 2A	H319: Causes serious eye irritation	SDS	N/A	Y	N
39		Dimethyl Benzyl Ammonium Chloride (60%), Dimethyl Ethylbenzyl Ammonium Chloride (68%)	1) Skin corrosion/irritation Cat. 2 2) Serious eye damage/eye irritation Cat. 2A	H315: Causes skin irritation H319: Causes serious eye irritation	Pubchem	N/A	Y	N
40		Ethanol (44.1%)	1) Acute toxicity (oral) Cat. 4 2) Serious eye damage/eye irritation Cat. 2B	H302: Harmful if swallowed H320: Causes eye irritation	Pubchem	N/A	Y	Y

No	Product Name	Hazardous ingredients	Hazardous classification	H-code	Source of information	Hazard Rating (HR)	Dermal (Y/N)	Ingestion (Y/N)
41		Isopropyl Alcohol (70%)	1) Serious eye damage/eye irritation Cat. 2A 2) 2) Specific target organ toxicity, single exposure Cat. 3	H319: Causes serious eye irritation H336: May cause drowsiness or dizziness	Pubchem	2	Y	N
42		Isopropyl Alcohol (75%)	1) Serious eye damage/eye irritation Cat. 2A 2) 2) Specific target organ toxicity, single exposure Cat. 3	H319: Causes serious eye irritation H336: May cause drowsiness or dizziness	Pubchem	2	Y	N
43		Alcohol Denatured Ethanol (75%)	1) Acute toxicity (oral) Cat. 4 2) Serious eye damage/eye irritation Cat. 2B	H302: Harmful if swallowed H320: Causes eye irritation	Pubchem	N/A	Y	Y
44		Benzalkonium chloride (0.310%), Didecyl dimethyl ammonium chloride (0.940%)	1) Acute toxicity (oral) Cat. 4 2) Acute toxicity, dermal Cat. 4 3) Skin corrosion/irritation Cat. 1 4) Skin corrosion/irritation Cat. 2 5) Sensitization, Skin Cat. 1 6) Serious eye damage/eye irritation Category 1 7) Serious eye damage/eye irritation Cat. 2A 8) Specific target organ toxicity, single exposure Cat. 3	H302: Harmful if swallowed. H312: Harmful in contact with skin. H314: Causes severe skin burns and eye damage. H315: Causes skin irritation. H317: May cause an allergic skin reaction H318: Causes serious eye damage. H319: Causes serious eye irritation H336: May cause drowsiness or dizziness	SDS	2	Y	Y
45		Isopropyl Alcohol (70%)	1) Serious eye damage/eye irritation Cat. 2A 2) Specific target organ toxicity, single exposure Cat. 3	H319: Causes serious eye irritation H336: May cause drowsiness or dizziness	Pubchem	2	Y	N
46		Alcohol (70%)	1) Acute toxicity (oral) Cat. 4 2) Serious eye damage/eye irritation Cat. 2B	H302: Harmful if swallowed H320: Causes eye irritation	Pubchem	N/A	Y	Y
47		Isopropyl alcohol (60-80%)	1) Serious eye damage/eye irritation Cat. 2A 2) Specific target organ toxicity, single exposure Cat. 3 3) Specific target organ toxicity, single exposure Cat. 3	H319: Cause serious eye irritation H335: May cause respiratory irritation H336: May cause drowsiness and dizziness	SDS	3	Y	N
48		Denatured Ethyl Alcohol (75%)	1) Acute toxicity (oral) Cat. 4 1) Serious eye damage/eye irritation Cat. 2A	H302: Harmful if swallowed H319: Cause serious eye irritation	SDS	N/A	Y	Y
49		Denatured Alcohol Ethanol (70%)	1) Acute toxicity (oral) Cat. 4 2) Serious eye damage/eye irritation Cat. 2B	H302: Harmful if swallowed H320: Causes eye irritation	Pubchem	N/A	Y	Y
50		Ethyl Alcohol (75%)	1) Acute toxicity (oral) Cat. 4 2) Serious eye damage/eye irritation Cat. 2B	H302: Harmful if swallowed H320: Causes eye irritation	Pubchem	N/A	Y	Y

APPENDIX 6: Table 3.6 (Exposure Rating for Inhalation)

Product Code	Product Name	Frequency Rating (FR)	Duration Rating (DR)	Frequency - Duration Rating (FDR)	Degree of Exposure or Exposure Level	Degree of Chemical Inhaled	Magnitude Rating (MR)	Exposure Rating (ER)	Hazard Rating (HR)	Risk Rating (RR)
2		5	1	3	Moderate	Low	2	3	2	6
3		5	1	3	Moderate	Low	2	3	3	9
7		5	1	3	Moderate	Low	2	3	2	6
13		5	1	3	Moderate	Low	2	3	3	9
18		5	1	3	Moderate	Low	2	3	2	6
19		5	1	3	Moderate	Low	2	3	4	12
22		5	1	3	Moderate	Low	2	3	3	9
23		5	1	3	Moderate	Low	2	3	2	6
26		5	1	3	Moderate	Low	2	3	2	6
27		5	1	3	Moderate	Low	2	3	2	6
29		5	1	3	Moderate	Low	2	3	4	12

Product Code	Product Name	Frequency Rating (FR)	Duration Rating (DR)	Frequency - Duration Rating (FDR)	Degree of Exposure or Exposure Level	Degree of Chemical Inhaled	Magnitude Rating (MR)	Exposure Rating (ER)	Hazard Rating (HR)	Risk Rating (RR)
30		5	1	3	Moderate	Low	2	3	4	12
31		5	1	3	Moderate	Low	2	3	3	9
33		5	1	3	Moderate	Low	2	3	3	9
38		5	1	3	Moderate	Low	2	3	2	6
37		5	1	3	Moderate	Low	2	3	2	6
39		5	1	3	Moderate	Low	2	3	3	9
41		5	1	3	Moderate	Low	2	3	2	6
44		5	1	3	Moderate	Low	2	3	2	6
45		5	1	3	Moderate	Low	2	3	2	6
47		5	1	3	Moderate	Low	2	3	2	6
48		5	1	3	Moderate	Low	2	3	3	9

APPENDIX 7: Table 3.14 (Dermal Assessment)

Product Code	Product Name	Relevant H-code	Hazardous Properties	Extent of Dermal Contact	Duration Exposure		Level of Risk
					Short term (<15 min/shift)	Long term (≥15 min/shift)	
1		H302: Harmful if swallowed H315: Causes skin irritation H320: Causes eye irritation	Irritation	Small	/	/	M2
2		H319: Causes serious eye irritation H336: May cause drowsiness or dizziness	Irritation	Small	/	/	M2
3		H302: Harmful if swallowed H315: Causes skin irritation H319: Causes serious eye irritation H335: May cause respiratory irritation	Irritation	Small	/	/	M2
5		H301: Toxic if swallowed H315: Causes skin irritation H320: Causes eye irritation	Irritation	Small	/	/	M2
6		H302: Harmful if swallowed H315: Causes skin irritation H320: Causes eye irritation	Irritation	Small	/	/	M2
7		H315: Causes skin irritation H320: Causes eyes irritation H336: May cause drowsiness or dizziness	Irritation	Small	/	/	M2
8		H302: Harmful if swallowed H314: Causes severe skin burns and eye damage H315: Causes skin irritation H319: Causes serious eye irritation	Corrosive Irritation	Small	/	/	H1
9		H319: Causes serious eye irritation	Irritation	Small	/	/	M2
10		H315: Causes skin irritation H320: Causes eye irritation H335: May cause respiratory irritation	Irritation	Small	/	/	M2

Product Code	Product Name	Relevant H-code	Hazardous Properties	Extend of Dermal Contact	Duration Exposure		Level of Risk
					Short term (<15 min/shift)	Long term (≥15 min/shift)	
11		H302: Harmful if swallowed. H312: Harmful in contact with skin. H315: Causes skin irritation. H319: Causes serious eye irritation	Acute toxicity Irritation	Small		/	M2
12		H319: Causes serious eye irritation	Irritation	Small		/	M2
13		H319: Causes serious eye irritation H336: May cause drowsiness or dizziness	Irritation	Small		/	M2
15		H302: Harmful if swallowed. H312: Harmful in contact with skin H315: Causes skin irritation H319: Causes serious eye irritation	Acute toxicity Irritation	Small		/	M2
17		H302: Harmful if swallowed H320: Causes eye irritation	Irritation	Small		/	M2
18		H302: Harmful if swallowed H312: Harmful in contact with skin H315: Causes skin irritation H318: Causes serious eye damage H319: Causes serious eye irritation H332: Harmful if inhaled H334: May cause allergy or asthma symptoms or breathing difficulties if inhaled	Acute toxicity Corrosive Irritation	Small		/	H2
19		H302: Harmful if swallowed H314: Causes severe skin burns and eye damage H318: Causes serious eye damage H335: May cause respiratory irritation	Corrosive Irritation	Small		/	H2
20		H302: Harmful if swallowed H320: Causes serious eye irritation	Irritation	Small		/	M2

Product Code	Product Name	Relevant H-code	Hazardous Properties	Extend of Dermal Contact	Duration Exposure		Level of Risk
					Short term (<15 min/shift)	Long term (≥15 min/shift)	
22		H319: Causes serious eye irritation H336: May cause drowsiness or dizziness	Irritation	Small		/	M2
23		H319: Causes serious eye irritation H336: May cause drowsiness or dizziness	Irritation	Small		/	M2
25		H302: Harmful if swallowed. H312: Harmful in contact with skin H315: Causes skin irritation H319: Causes serious eye irritation	Acute toxicity Irritation	Small		/	M2
26		H302: Harmful if swallowed H318: Causes serious eye damage H320: Causes eye irritation H336: May cause drowsiness or dizziness	Corrosive Irritation	Small		/	H2
27		H302: Harmful if swallowed H305: May be fatal if swallowed and enters airways H320: Causes eye irritation H335: May cause respiratory irritation H336: May cause drowsiness or dizziness H371: May cause damage to organs	Irritation Skin absorption and other properties	Small		/	M2
29		H302: Harmful if swallowed H312: Harmful in contact with skin H315: Causes skin irritation H319: Cause serious eye irritation H332: Harmful if inhaled H335: May cause respiratory irritation H336: May cause drowsiness and dizziness H350: May cause cancer	Acute toxicity Irritation	Small		/	H1
30		H320: Causes eye irritation H335: May cause respiratory irritation	Irritation	Small		/	M2

Product Code	Product Name	Relevant H-code	Hazardous Properties	Extend of Dermal Contact	Duration Exposure		Level of Risk
					Short term (<15 min/shift)	Long term (≥15 min/shift)	
31		H302: Harmful if swallow H312: Harmful in contact with skin H315: Causes skin irritation H317: May cause an allergic skin reaction H320: Causes eye irritation H335: May cause respiratory irritation	Acute toxicity Irritation Sensitisation	Small		/	M2
32		H302: Harmful if swallow H314: Causes severe skin burns and eye damage H318: Causes serious eye damage	Corrosive	Small		/	H2
33		H319: Causes serious eye irritation H336: May cause drowsiness or dizziness	Irritation	Small		/	M2
34		H302: Harmful if swallowed H320: Causes eye irritation	Irritation	Small		/	M2
36		H319: Causes serious eye irritation H336: May cause drowsiness or dizziness	Irritation	Small		/	M2
37		H315: Causes skin irritation H320: Causes eye irritation H335: May cause respiratory irritation	Irritation	Small		/	M2
38		H319: Causes serious eye irritation	Irritation	Small		/	M2
39		H315: Causes skin irritation H319: Causes serious eye irritation	Irritation	Small		/	M2
40		H302: Harmful if swallowed H320: Causes eye irritation	Irritation	Small		/	M2

Product Code	Product Name	Relevant H-code	Hazardous Properties	Extend of Dermal Contact	Duration Exposure		Level of Risk
					Short term (<15 min/shift)	Long term (≥15 min/shift)	
41		H319: Causes serious eye irritation H336: May cause drowsiness or dizziness	Irritation	Small		/	M2
42		H319: Causes serious eye irritation H336: May cause drowsiness or dizziness	Irritation	Small		/	M2
43		H302: Harmful if swallowed H320: Causes eye irritation	Irritation	Small		/	M2
44		H302: Harmful if swallowed. H312: Harmful in contact with skin. H314: Causes severe skin burns and eye damage. H315: Causes skin irritation. H317: May cause an allergic skin reaction H318: Causes serious eye damage. H319: Causes serious eye irritation H336: May cause drowsiness or dizziness	Acute toxicity Corrosive Irritation	Small		/	H2
45		H319: Causes serious eye irritation H336: May cause drowsiness or dizziness	Irritation	Small		/	M2
46		H302: Harmful if swallowed H320: Causes eye irritation	Irritation	Small		/	M2
47		H319: Cause serious eye irritation H335: May cause respiratory irritation H336: May cause drowsiness and dizziness	Irritation	Small		/	M2
48		H302: Harmful if swallowed H319: Cause serious eye irritation	Irritation	Small		/	M2
49		H302: Harmful if swallowed H320: Causes eye irritation	Irritation	Small		/	M2
50		H302: Harmful if swallowed H320: Causes eye irritation	Irritation	Small		/	M2

APPENDIX 8: Table 3.17 (The Level of Health Risk)

No	Risk Rating, RR (inhalation)	Level of Risk Determination for Inhalation Exposure (RR = HR x ER)			Risk for Dermal Exposure		
		Low Risk (RR = 1-4)	Moderate risk (RR = 5 -12)	High Risk (RR= 15- 25)	Low Risk (L)	Moderate risk (M1 & M2)	High Risk (H1 & H2)
1	N/A		N/A			M2	
2	Moderate		8			M2	
3	Moderate		9			M2	
4	N/A		N/A			N/A	
5	N/A		N/A			M2	
6	N/A		N/A			M2	
7	Moderate		8			M2	
8	N/A		N/A				H1
9	N/A		N/A			M2	
10	N/A		N/A			M2	
11	N/A		N/A			M2	
12	N/A		N/A			M2	
13	Moderate		9			M2	
14	N/A		N/A			N/A	
15	N/A		N/A			M2	
16	N/A		N/A			N/A	
17	N/A		N/A			M2	
18	Moderate		8				H2
19	Moderate		12				H2
20	N/A		N/A			M2	
21	N/A		N/A			N/A	

22	Moderate	9	M2
23	Moderate	6	M2
24	N/A	N/A	N/A
25	N/A	N/A	M2
26	Moderate	6	H2
27	Moderate	6	M2
28	N/A	N/A	N/A
29	Moderate	12	H1
30	Moderate	12	M2
31	Moderate	9	M2
32	N/A	N/A	H2
33	Moderate	9	M2
34	N/A	N/A	M2
35	N/A	N/A	N/A
36	Moderate	6	M2
37	Moderate	6	M2
38	N/A	N/A	M2
39	Moderate	9	M2
40	N/A	N/A	M2
41	Moderate	6	M2
42	N/A	N/A	M2
43	N/A	N/A	M2
44	Moderate	6	H2
45	Moderate	6	M2
46	N/A	N/A	M2
47	Moderate	6	M2
48	Moderate	9	M2
49	N/A	N/A	M2
50	N/A	N/A	M2