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The Benefits and Risks of Spraying Disinfectants in The Public Spaces During The Coronavirus Disease 2019 (Covid-19) Pandemic: A Literature Review Study

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A B S T R A C T

Coronavirus Disease 2019 (COVID-19) spreads quickly through droplets from the patient's nose or mouth, falls on objects around them, and becomes the transmission source for others. Therefore, the community prevents COVID-19 transmission by spraying disinfectants in the environment and using sanitary booths for humans despite not being recommended by the Indonesian government and WHO because it's a health risk. This study analyzes the benefits and risks of spraying disinfectants in public spaces during the Coronavirus Disease 2019 pandemic. This study used six database sources: Pubmed ScienceDirect, ResearchGate, Google Scholar, *Pusat Penelitian dan Pengembangan Upaya Kesehatan Masyarakat (Puslitbang Ukesmas)*, and Elsevier during 2016-2021, with inclusion and exclusion criteria selected by the authors on PRISMA flow diagram. There were 15 articles matching those criteria. Nine concluded that spraying disinfectants in the community could prevent the spread of COVID-19. In addition, it was efficient for surface objects and large areas. Furthermore, ≤ 200 ppm chlorine-based disinfectants and 15% alcohol-based were safe to use. Meanwhile, six articles revealed a risk of spraying disinfectants due to improper disinfectants mixing and spraying disinfectants on food and the body. In conclusion, spraying disinfectants in the community is safe for the eyes, respiratory tract, and skin of humans. It also can prevent the spread of Coronavirus Disease 2019 when the method, material, and usage are appropriate.

INTRODUCTION

Coronavirus Disease 2019 (COVID-19) causes acute respiratory syndrome. The first case of the disease was reported in Wuhan, China, in December 2019. Then, World Health Organization (WHO) declared a Public Health Emergency outbreak on January 30, 2020. SARS-CoV-2 has a fragile outer lipid envelope, making it more susceptible to disinfectant than other non-enveloped viruses. It spreads rapidly through an infected person's droplets that fall on a nearby object (WHO, 2020).

Due to the unavailability of precise Coronavirus Disease 2019 medicine (Wardani *et al.*, 2022), the vaccine has become a big hope in facing the pandemic, even when only half of the community is vaccinated. A probability study concluded that when 80% of the population were vaccinated, the daily risk of infection would be reduced by 50% under the condition that the public strictly followed Coronavirus Disease 2019 health protocols (Abo and Smith, 2020). However, there is a chance that the virus mutation's ability be more dangerous after vaccination due to its antibody-dependent enhancement (ADE) (Nidom *et al.*, 2020). Therefore, World Health Organization gives a guideline for cleaning and disinfection environmental surfaces to prevent virus transmission. That guideline uses lipid solvent or hypochlorite disinfectant of

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0.1% (1000 ppm) for general environment disinfection and also 0.5% for surfaces with body fluids spills, such as blood, etc., as well as ethanol with 70-90% of concentration, and hydrogen peroxide of > 0.5% within 1-minute contacts (WHO, 2020).

With knowledge of the virus susceptibility towards a cleansing solution (lipid solvent, soap, etc.) and disinfectant, the general public can perform prevention, including in Indonesia, by disinfecting various facilities such as public spaces. Unfortunately, massive disinfection in public areas such as parks, roads, and disinfection booths became controversial because it can pollute food sources, water, and animal habitat (Nabia *et al.*, 2020). The Indonesian Ministry of Health, circular number HK.02.02/III/375/2020, doesn't advise using disinfection booths in public spaces due to their health risk (Kemenkes, 2020). Although so far, the general public, government, and private agencies in various cities in Indonesia still perform mass spraying disinfectants. They believe it can reduce COVID-19 transmission without considering the risks. One case was in Eastern Jakarta in early November 2020, using 1.716 units of disinfectant spraying vehicles and 34.515 crew of Jakarta Sub-dept of Fire and Rescue Service (Aini Tartinia, 2020). These mass spraying disinfectants were performed until January 25, 2021, by the Indonesian State Intelligence Agency in Medan Merdeka Timur Street, Jakarta (Ardhi, 2021).

An experimental study found that 15% alcohol in concentration could cause disintegration in the virus membrane (Eslami *et al.*, 2020). Another study concluded that 50 ppm chlorine (ClO2) in concentration showed the ability to significantly hinder the virus activity by 95.91% (Ma *et al.*, 2017). However, the previous research done by Althea et al. in an article titled "Implementation of Disinfection in COVID-19 Prevention and Its Potential Risk to The Health of Indonesia" with a cross-sectional method concluded that disinfection during the COVID-19 Pandemic in Indonesia caused health risks (Athena, Laelasari and Puspita, 2020).

This study analyzes the benefits and risks of spraying disinfectants in public spaces, especially during the COVID-19 pandemic, so it can clear the controversy by providing scientific evidence. In other words, proper spraying of disinfectants in public spaces can give excellent benefits with minimum risks.

METHOD

The method used in this study was a literature review, with articles or previous studies as resources (Nursalam, 2020) through six database sources: Pubmed, ScienceDirect, ReseachGate, Google Scholar, *Pusat Penelitian dan Pengembangan Upaya Kesehatan Masyarakat (Puslitbang Ukesmas)*, and Elsevier, during 2016 – 2021. In the data collection process, the authors used keywords with the Boolean operator (AND, OR, OR NOT, AND NOT). Table 1 shows the summary of keywords searched in this literature review.

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Table 1 Summary of Keywords Searched in the Literature Review

COVID-19	Spraying	Disinfectant	Public Spaces	Benefit	Risk
OR	*OR*	*OR*	*OR*	*OR*	*OR*
Coronavirus/ Novel coronavirus	*Semprot/ penyemprotan*	*Pemutih*/ chlorine/ CL/Chlor/ bleach	Public	*Keuntungan*	*Dampak*
OR	*OR*	*OR*	*OR*	*OR*	*OR*
Corona Sars-2	Spraying	Disinfectants	Environment/environmental	Benefit	Risk
OR	*OR*	*OR*	*OR*	*OR*	*OR*
Corona Virus/ viruses	Fogging/ aerosol	*Disinfeksi/* Disinfections	outdoor	Advantage	Impact

Keywords for article searches were COVID-19, spray, disinfectant, public spaces, benefit, and risk. The reason for expanding the keywords 'spray' to *Penyemprotan*, *Semprot*, spraying, and fogging/ aerosol was to obtain reputable articles within and outside the country. In addition, the reason for developing the keywords 'COVID-19' to coronavirus, corona SARS-2, and corona disease was because foreign researchers often use these words. Furthermore, the reason for expanding the keywords 'public spaces' to the public, environment/environmental, and outdoor was because the terms were used in foreign language research. Previous researchers also revered 'disinfectants' with *Pemutih* or bleach, disinfectant/ disinfection/ *Disinfektan*, and *Klorin*/chlorine. Chlorine was used in daily activities, known as *Bayclin*, *Proclin*, *Soklin Pemutih*, *Wipol, SOS antibacterial*, etc.

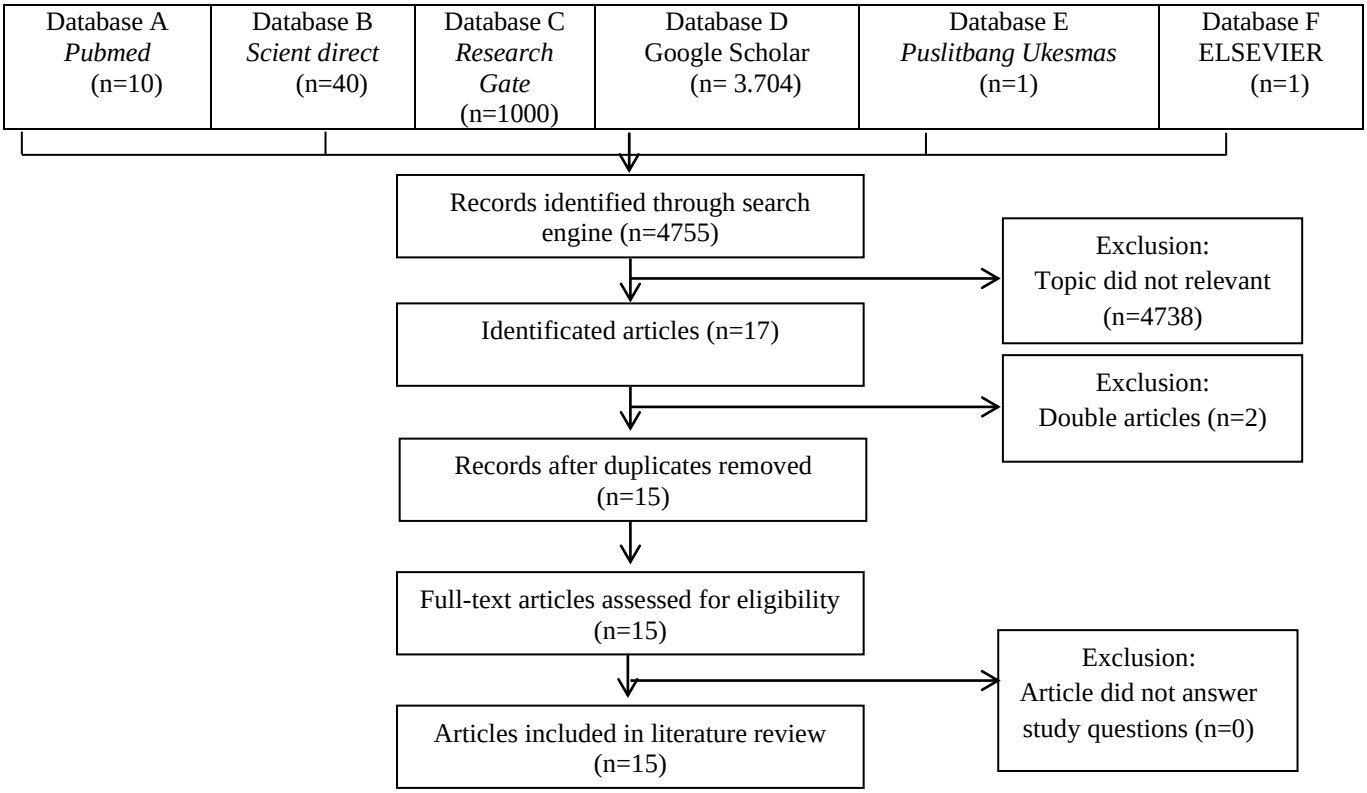

Figure 1. PRISMA Flow Diagram of the Literature Review

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The authors performed a literature review on 15 collected journals with the criteria selected by the author, such as relevancy with title and theme, full-text, a certain period, the study systematics, and content relevance. Furthermore, researchers analyzed the similarity and differences between articles and explained the results from the article's extraction in critical scientific discussion.

RESULT

The authors did skim in 4755 articles identified through the search engine. Then, we excluded 4738 of them due to the title's irrelevancy because of not discussing the benefits and risks of spraying disinfectants. Next, two were identified as double articles with the same theme and title from two different database sources. The final results were 15 articles in table 2.

Table 2. Summary of the Literature Review Findings

No.	Author	Journal Name, Volume (Num.), Year	Title	Method (Design, Sample, Variable, Instrument, Analysis)	Results	Conclusion	Suggestion
1.	(Cadnum *et al.*, 2020)	American Journal of Infection Control 48 (2020) 951−954	Evaluation of an electrostatic spray disinfectant technology for rapid decontamination of portable equipment and large open areas in the era of SARS-CoV-2	This study experimented with a disinfectant spraying machine. It aimed to evaluate the effectiveness of the electrostatic disinfectant spraying machines in portable equipment and hard-to-reach areas. The study Sample was 30 wheelchairs, 40 portable medical equipment, and 30 waiting chairs. Disinfectants utilized sodium Hypochlorite 0.25% and let dry without wiping (around 5 minutes). There was an evaluation of swab culture of *E-coli* and *C.difficile* spores before and after spraying. Data analysis used Fisher's exact test to determine the differences in bacterial culture of each sample.	Sodium Hypochlorite sprayed on a steel plate surface could reduce the C. difficile Spore by ≥ 6.0 log10 in a colony formation within 5-minutes. In addition, it could lower the MS2 Bacteriophage by ≥ 6.0 log10 PFU within a 2-minutes contact. There was significantly reduced contamination in every site after spraying disinfectant ($p \leq 0.1$ for each comparison). A curved or vertical surface approximately needed 2-minutes of drying time. Therefore, a longer disinfectant spray time was crucial.	Spraying disinfectant with an electrostatic spray quickly and effectively decontaminated portable equipment and a large open area. Therefore, it can use in the Coronavirus Disease 2019 pandemic.	During the Coronavirus Disease 2019 pandemic, 0.25% Sodium Hypochlorite could disinfect large areas using a portable electrostatic spraying machine.

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2.	(Eslami *et al.*, 2020)	The Journal of Physical Chemistry, 124(46):10374-10385 November 2020	How Alcoholic Disinfectants Affect Coronavirus Model Membranes: Fluidity, Permeability, and Disintegration	This study experimented with meta dynamics simulation to check virus-cell failure when induced with 5%, 10%, and 15% alcohol. 2 samples used 17.5% alcohol-based disinfectants (ethanol) and 15% concentrated n-propanol, also 15% concentrated n-propanol at 298 K, 315 K and 323K temperature.	5% and 10% alcohol did not have enough energy to weaken the virus membrane significantly. 15% alcohol could disintegrate the virus membrane reliably.	15% alcohol or more in a minimum of 298 K temperature would disintegrate the virus membrane. In addition, n-propanol had more significant results than ethanol.	Use a minimum of 15% Alcohol in 208 K for disinfection and eliminate Coronavirus Disease 2019.
3.	(Weinmann *et al.*, 2017)	Occup Environ Med 2017 as 10.1136/oemed-2016-104086	Association of household cleaning agents and disinfectants with asthma in young German adults	This research used the cohort method between 2007-2009, 2015, and 2021, with 19-24 years old young adult population living in two big cities in Germany. There were 3785 samples of the participant between the age of 16 and 18 years old. This study aimed to observe the use of domestic spray and disinfectants on asthma incidence in adults and young adults in school-life to work-life transition.	The survey showed that the frequency of domestic use of spray/disinfectants was 0, <1, 1–3, or 4–7 days weekly. Disinfection methods were spraying, hand washes with disinfectant soap, disinfecting machine, cleaning surfaces with sponges and disinfectant, scrubbing the floor with disinfectant, and others. High use of disinfectants could increase the incidence of asthma by 2.79 times.	The usage of domestic spray correlated with asthma incidence in frequent disinfectant spray users	Awareness campaigns to improve knowledge about the detrimental health effects of cleaning agents were essential. In addition, developing less harmful products were crucial.
4.	(Rabby *et al.*, 2020)	MMWR. Morbidity and mortality weekly report · June 341947151 2020	Knowledge and Practices Regarding Safe Household Cleaning and Disinfection for COVID-19 Prevention — United States, May 2020	This descriptive observational study aimed to describe the significant increase of food poisoning phone calls to US Poison Centers related to cleansing solvent and disinfectants exposure since the beginning of the Coronavirus Disease 2019 pandemic. The population was domestic disinfectants users in the USA	Respondents reported via an online survey about their usage of dangerous substances such as bleach in food (i.e., fruits and vegetables) (19%), the use of domestic cleaning products, and disinfectant on hands or skin (18%). In addition, 10% of respondents sprayed disinfectant on the body, 6% inhaled cleaning products or disinfectant steam, and drank or gargled with liquid bleach,	25% of the respondents reported nose or sinuses irritation, skin irritation (8%), eye irritation (8%), dizziness or headache (8%), stomach ache or nausea (6%), and breathing problems (6%).	Disinfectants should not be used directly on the body, especially not for gargling or inhaling.

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				The sample was 502, 46 years old on average (between 18 and 86 years old), with 52% of respondents being female. In addition, 63% of respondents were of white non-Hispanic descent, 16% of Hispanic, 12% of black non-Hispanic, and 8% of multirace or other races.	water, soap, cleaning solvent, and other disinfectant products (4% each).		
5.	(Ma *et al.*, 2017)	International Journal of Environmental Research and Public Health 14(3):329, 2017	Efficacy and Safety Evaluation of a Chlorine Dioxide Solution	This experimental study aimed to find the effect, toxin, and biocides of distilled and diluted chlorine on a specific sample. It utilized 0.2% (0.2 mg/L) electrolytically distilled chlorine dioxide using a membrane and diluted afterward. After chlorination, the study analyzed microbial activity, bacteria, and viruses in mice and rabbits.	Chlorine found on general markets has low purity due to the high presence of other substances such as H_2SO_4 (10%), 5% HCl and $NaClO_2$ (15%) or by-products such as Cl_2 and anion chloroxylenol. So, chlorine dioxide had a high presence of other substances and could only be used for wastewater treatment, and was not suitable for human contact due to its dangerous substance. The result of antimicrobial testing results showed that bacteria and fungus were reduced by more than 98.2% when the chlorine concentrations were 5 and 20 ppm. In addition, the lung fibroblast cell viability of L929 mice was 93.7% in 200 ppm chlorine. 50 ppm chlorine did not show any sign of eye irritation on rabbits. 40 ppm in drinking water did not indicate toxicity. Antivirus activity tested from 0, 25, 50, 100, and 200 ppm in 2-minutes on EV71 Influenza virus, 50 ppm CLO2 showed	Distilled CLO2 had satisfying antibacterial, anti-fungus, and antivirus activity. 1) 200 ppm Cl was most efficient in significantly hindering the H1N1 and B/TW/71718/04 influenza viral plaque formation in 2-minutes and enterovirus in 59 ppm 2) 50 ppm ClO2 did not cause eye irritation, abnormality, and fatality in an inhalation toxicity test in rabbits 3) ClO2 of 20-40 ppm was not toxic for mice for 90 days.	200 ppm Chlorine was safe and effective in killing the virus.

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					significant hinder in activities by 95.91%.		
6.	(Luo, 2020)	Luon Energy LLC March 2020	Stop COVID-19 with Air Spray of a Hypochlorite Solution	This experimental study in China and USA aimed to find the benefits and risks of 0.1-0.5% chlorine disinfectant spraying in a group of people. There was no mention in the study population number. The study Sample was more than 200 people. A spraying test was performed in the workplace using Hypo chlorine of 0.1-0.5% once daily.	There was no report of COVID-19 cases and allergic reactions within this group. In addition, the disinfectant spray was safe for furniture and colored fabric. Hypochlorite steam around the neck potentially could stop coronavirus transmission through droplets or aerosols.	Hypochlorite (0.1-0.5%) was safe to use around dresses or hands before and after being exposed to a highly contaminated area. The cell DNA was at least 200 times better protected against Chloride than a viral RNA. So, spraying disinfectants could kill the virus and be safe for humans.	Hypochlorite was safe to use in a workplace with high COVID-19 risk without inducing risk.
7.	(Yasseen *et al.*, 2021)	Health Promotion and Chronic Disease Prevention in Canada Vol 41, No 1, January 2021	Increases in exposure calls related to selected cleaners and disinfectants at the onset of the COVID-19 pandemic: data from Canadian poison centers	This observational research was based on the increase of emergency calls in Canadian Poison Centers due to the effects of certain cleaning products and disinfectants used at the beginning of the COVID-19 pandemic. This study aimed to describe the reason for those increased calls.	From January to June 2019 and 2020, there were 3408 (42%) reported emergency calls related to misuse of bleach usage, 2015 (25%) for hand cleaning, 1667 (21%) for disinfecting, 949 (12%) as chlorine gas, and 148 (2%) as chloramine gas.	Related reasons for an increase in cleaning products usage were: 1) products' limited availability causing incorrect use of products, such as mixing them with other products 2) Misuse of the products as personal hygiene or decontaminatio n 3) bigger exposure for children at home	It was crucial to read instructions before using the disinfectant. In addition, avoid their exposure to children.
8.	(Wiemken *et al.*, 2016)	American Journal of Infection Volume 44, Issue 12, December 1, 2016, Pages 1698-1699	Disinfectant sprays versus wipes: Applications in behavioral health	This observational study aimed to evaluate the use and ability of disinfectant spray and hydrogen peroxide wipes to disinfect equipment routinely. Thus,	ATP-RLU reading showed that the spraying method was significantly lower than wipes (median sequentially, 1.767 vs. 22.892 with p= 0.002 and monthly median sequentially, 2.296 vs.	The study suggested that the disinfectant sprays might be helpful for cleaning and disinfection behavior in health care	Disinfectant sprays had better performanc e than wipes.

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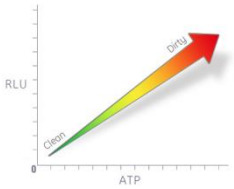
				there was increasing in healthy behavior in an outpatient facility in Louisville, KY, from July-October 2014. ATP meter evaluated the efficiency of the cleaning process and disinfection in the spraying method and wipes (relative light unit). In addition, a short survey method with 30 observations for every 15 sprayings and every 15 wipes evaluated healthy behavior. Statistical analysis used the Mann-Whitney U test to examine the statistical difference between each method's RLU ATP median readings.	19.371 with p<0.001).  Besides lower ATP-RLU values, a behavioral usage survey showed that 83% of staff preferred cleaning equipment or props using spray rather than wiping.	facilities.	
9.	(Maharani and Hendrasarie, 2020)	Article Vol. 1 No. 1 (2020): Seminar Nasional (ESEC) 2020	The effectivity of aerosol disinfectants on reducing Bacteria, Fungus, and their Impact on Human Skin	This qualitative research aimed to find the effectiveness of aerosol disinfectant in reducing bacteria and fungus and their effects on human skin. The study used convenience sampling. It was conducted in six locations (disinfection booths, disinfection location points, and disinfectant spraying vehicles) in the Wadung Asri Ward. The authors swabbed respondents' hands to test the presence of bacteria and fungus. Then, spraying disinfectant was carried out with	Location A (booth) using NaOCl/ *bayclin* of 0.3% and C_8H_9OCl / *Dettol* 0.01% (from 4.8% *dettol*) were most effective in killing microbes (99%). Location B (spraying) using $C_6H_5CH_2N(CH_3)2RCl$ of 0.02% / Benzalkonium Chloride of 20% had more than 58% effectiveness. Location C (spraying) using NaOCl/ *Bayclin* of 0.005% alongside $C_{10}H_{18}O$ / *Wipol* of 0.002% Plus Pine oil of 2.5%, and $C_6H_5CH_2N(CH_3)2RCl$ / *So Klin Lantai* of 0.0015% (diluted *Soklin* 1.5%) showed an effectiveness of	Aerosol disinfectants that effectively reduced bacteria and fungus and had no impact on respondents were NaOCl of 0.3% and C8H9OCl of 0.01%, using a spraying method within 0.5-meter of spraying distance.	Spraying NaOCl of 0.3% and C_8H_9OCl of 0.01% within 0.5-meter were effective and safe for reducing fungus and bacteria.

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				three distance variations: 2 m, 1 m, and 0.5 m. After spraying the disinfectants at these three distances, the researchers did a swab on respondents, and respondents filled out a questionnaire on the disinfectant spray impact.	90%. Location D (booth) using C_8H_9OCl / *Dettol* of 0.014% and *So Klin Lantai* of 0.0015% indicated the effectiveness of 90%. Location E (spraying) using NaOCl of 0.05% (obtained from 5% NaOCl) had an effectiveness of 90%. Location F (disinfectant spraying vehicle) using NaOCl of 0.01% (obtained from 5% NaOCl) and $C_{10}H_{18}O$ of 0.05% (obtained from *Wipol* with Pine oil of 2.5%). On locations A, D, and E with a 0.5-meter spraying distance, there was no reported irritation/itchiness on the hands. In locations B, C and F, there was reported itchiness and burning sensation, each happening after 1, 3, and 5 minutes. The impacts happened to female respondents.		
10	(Ahmad Zulfikri1 and 1, 2020)	*Menara Medika* 2 Journal Public Health Faculty in University of *Islam Negeri* North Sumatera Medan	The impact of liquid disinfectant on COVID-19 disinfectant spraying team in the City of Binjai	This qualitative study used a phenomenology design through an in-depth interview with five informants who performed the disinfectant spraying during the COVID-19 pandemic.	Five informants stated that liquid disinfectants could cause itchiness, dryness, and peeling at skin contact during disinfectant spraying. Informants used PPEs during the spraying process, but they were not worn PPE during the ingredients mixing. However, there was no discussion on disinfectant concentration percentage in this study.	Liquid disinfectants caused skin irritation, itchiness, and a burning sensation at skin contact in all informants. However, there was no impact on informants when using safety gloves.	Individuals who perform disinfection should use PPE during preparation.

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11.	(Casey *et al.*, 2017)	American Journal of Infection Control 2017 45(10): 1133-1138	Health Problems and disinfectant product exposure among staff at a large multispecialty hospital	This study was a quantitative study with an analytic observational design. It used a questionnaire about work and health characteristics as instruments. In addition, it utilized an air quality observational sheet based on OSHA (Occupational Safety and Health Administration) and NIOSH (National Institute for Occupational Safety and Health) with air acidity limits of 0.2 ppm. The respondents were 163 health staff. In addition, 49 air samples were analyzed for hydrogen peroxide, peracetic acid, and acetic acid content. Data analysis used Poisson regression to analyze Prevalence ratios (PRs) and national representative data to count standardized morbidity ratios (SMRs).	The prevalence of watery eyes in disinfectant product users related to work was higher than in non-user ($p<0.05$). Workers in a department with the highest air measurement had significantly higher watery eyes prevalence (PRs=2.88 with confidence intervals of 95%) compared to staff in lower air measurement. They also had more than three times the chances of experiencing asthma (SMRs=3.47 with 95% CI, 1.48-8.13) compared to the average Americans.	Disinfectant products containing hydrogen peroxide, peracetic acid, and acetic acid could affect the mucous membrane and respiratory system in humans. Hospitals should consider health workers' risk of developing irritating mucous membranes and asthma when developing disinfection protocols to protect patients from nosocomial infections. Identifying optimum disinfection protocols could reduce disinfectant exposure on workers while protecting patients' safety.	Better disinfection protocols were essential to minimize the risk of disinfectant product exposure to workers in the hospital.
12.	(Dindarloo *et al.*, 2020)	Journal of Environmental Health Science and Engineering 2020	Pattern of Disinfectants Use and Their Adverse Effects on the Consumers After COVID-19 Outbreak	This cross-sectional study from April -March 2020 aimed to find the use and effects of disinfectants during the COVID-19 pandemic. The population was 4480 Hormoz Gan province citizens in Iran infected with COVID-19. The estimated	87% of the respondents used the wrong portion of water and alcohol when making disinfectants. 42% of respondents experienced interferences in their hands, legs, eyes, respiratory, or digestion systems. The most experienced interferences were dryness of the skin, obsession, itchiness, coughing, and eye	Respondents were not used to preparing and using a disinfectant. There were disinfectant preparations with too high of a concentration. Mostly, disinfectant storages were unsafe, and ways of	A higher concentration of disinfectant than advised use was prohibited. In addition, a safe storing place was essential. Both could avoid the health

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				sample was 384 cases based on the Cohen table with a 5% error standard. The instrument was a digital questionnaire with a total of 46 questions, including respondents' demographic characteristics, disinfectant usage patterns, and health effects of disinfectants experienced by respondents. Data analysis used SPSS 22 descriptive analysis to find the frequency, mean score, and standard deviation. In addition, it utilized a T-test and one-way ANOVA.	irritation.	throwing the empty disinfectant containers were incorrect.	effects of disinfectant usage.
13.	(Chang *et al.*, 2020)	Morbidity and Mortality Weekly Report 69(16) 2020 :496–498	Cleaning and Disinfectant Chemical Exposures and Temporal Associations with COVID-19 — National Poison Data System, United States, January 1, 2020–March 31, 2020	This descriptive-quantitative study aimed to describe health problems experienced by consumers due to disinfectant usage during the COVID-19 pandemic. The study sample was phone call data from The US Poison Center with total sampling.	Daily phone calls to The US Poison Center rapidly increased in early March 2020. Poisoning happened among all ages, but the highest percentage was in children ≤ 5 years. There was an increase in cleaning products and disinfectant exposure in 2019-2020. Furthermore, there was a case study of a patient experiencing light hypoxemia and wheezing.	The increase of reported disinfectant exposure cases possibly happened due to incorrect use of disinfection and not according to the guidelines provided on product labels. In addition, there was a mixing of several chemical substances.	It was crucial to read usage instructions before using a disinfectant. In addition, mixing multiple disinfectants was dangerous.
14.	(Nafilah and Muflihah, 2020)	*Prosiding penelitian dan pengabdian kepada masyarakat Universitas Islam Negeri Sunan Ampel Surabaya*	Tactical steps Coronavirus Disease 2019 prevention in Lowayu, Dukun, Gresik	This qualitative study with observational data collection and in-depth interviews aimed to describe the community's behavior in applying health protocols. The subject were	Organizations, volunteers, and the village government in Lowayu prevent COVID-19 by socialization, forming volunteers and a Covid-19 Task Force, and mass disinfectant spray in potentially crowded areas, such as the	Spraying disinfection in crowded places such as mosques and markets was safe.	Mass spraying disinfectants could reduce COVID-19 transmission.

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		August 2020 Vol 7 no. 2		village government and COVID-19 volunteers in Lowayu, Dukun, Gresik. Data analysis used the triangulation method.	mosques and two traditional markets. In addition, sellers and buyers were regulated only by local people, providing automatic disinfection booths on two gateway, a mandatory mask use policy, free mask distribution, and providing handwashing sites. However, there were no COVID-19 cases yet at Lowayu, causing some people not to apply health protocols. In addition, there was still no strict penalty for those who didn't perform COVID-19 health protocols.		
15.	(Chui *et al.*, 2021)	International Journal of Environmental Research and Public Health Vol. 18 no. 117 the year 2021	Environmental Contamination of SARS-CoV-2 in a Non-Healthcare Setting	This analytics-observational study aimed to investigate SARS-CoV-2 presence in non-treatment environments (accommodation and transit rooms) and assess the efficiency of cleaning and COVID-19 disinfection. The samples were 428 surface swabs and six air samples from 18 sampling locations, i.e., accommodation rooms, toilets, and elevators previously used by individuals with COVID-19. Surface swabs data collection used sterile synthetic swabs, and air samples utilized a cyclonic air sampler.	Two of the 428 swab samples were positive for SARS-CoV-2 RNA. Positive samples were from walls nearby the accommodation room bed before disinfection and cleaning. There were potential virus contaminations on the surface of the rooms for COVID-19 cases in the long term. So, it regularly needed cleaning and regular disinfection on its surface inside or outside the rooms, especially when there was potential COVID-19 transmission.	Viral load detection in the accommodation rooms of a COVID-19 confirmed case highlighted the importance of disinfection in the community, especially in the rooms used by individuals with COVID-19, to avoid transmission.	Frequent public space cleansing could potentially reduce COVID-19 transmission in the community.

The results of this literature review from 15 articles showed that nine concluded that spraying disinfectants in the community or hospital environment provided benefits with no risks, namely, journals

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number 1,2,3,5,6,8,9,14,15. Meanwhile, the other six articles concluded there were risks such as skin, eye, and respiratory tract irritation.

DISCUSSION

A study of the effectiveness of electrostatic spray disinfectant technology on flat and curved surfaces and hard-to-reach areas using 0.25% Sodium Hypochlorite showed significantly reduced contamination (Chui *et al.*, 2021). Furthermore, research revealed that the ATP-RLU median value of the spraying method was substantially lower than the wiping method, indicating that the spraying method of disinfection was more effective (Wiemken *et al.*, 2016).

According to World Health Organization's guidelines, Chlorine-based disinfectants are used at around 0.1% or 1000 ppm, meanwhile 60%-70% for alcohol-based (risk can be minimalized using a minor concentration). In addition, 15% alcohol on 298K or 24.85C could effectively disintegrate the virus membrane (Eslami *et al.*, 2020). Meanwhile, a study revealed that 200 ppm of chlorine in 2 minutes could 95.91% inhibit of H1N1 influenza virus, specifically at 84.65 ± 0.64 ppm. Furthermore, there was significant inhibition during the 2 minutes of EV71 on influenza virus B/TW/71718/04 95.91 ± 11.61 ppm and 50 (46,39 ± 1,97). In addition, the study also showed that 50 ppm ClO2 did not irritate rabbit eyes, 20 ppm did not show abnormality and fatality on inhalation toxicity testing, and 20-40 ppm ClO2 was not toxic to mice during 90 days period (Ma *et al.*, 2017). Other research also found that spraying 0.1-0.5% hypochlorite towards respondents' gowns and hands after exposure to a highly COVID-19 infected area did not cause allergic reactions or COVID-19 transmission in respondents (Luo, 2020).

Meanwhile, a cohort study from 2007 to early 2021, which will be continued in 2051, showed a weak correlation between the high domestic use of disinfectants and respiratory diseases, specifically asthma. Asthma incidents upon disinfectant usage were only 2.79% (Weinmann *et al.*, 2017). It means that the domestic use of factory-made disinfectants is safe for long-term application. A qualitative study of NaOCl 0.3% and C8H9OCl 0.01% (*Dettol*) aerosol disinfectants at a 0.5-meter distance effectively reduces bacteria and fungus without adverse events to respondents (Maharani and Hendrasarie, 2020). A study showed there was not yet COVID-19 infection found in Lowayu, Gresik, most likely due to mass disinfection in crowded areas (such as mosques and markets) and providing two disinfection booths in the market's entrance and exit gate (Nafilah and Muflihah, 2020).

However, several studies reported that spraying disinfectant potentially causes risks. A study reported that 42% of respondents experienced inconvenience in their hands, feet, eyes, respiratory, and digestive systems. In addition, 87% of respondents used the wrong proportion of 85-99% water-alcohol and 0.5% chlorine-water (Dindarloo *et al.*, 2020). Research also showed disinfectants misuse consisted of using

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bleach on food items (e.g., fruits and vegetables) (19%), utilizing household cleaning and disinfectant products on hands or skin (18%), spraying the body with a cleaning or disinfectant spray (10%), and inhaling vapors from household cleaners or disinfectants (6%). In addition, respondents in that research drank or gargled with diluted bleach solutions, soapy water, and other cleaning and disinfectant solutions (4% each) (Gharpure *et al.*, 2020).

Furthermore, observation on Canadian Poison Center calls related to misuse of home cleaning products and disinfectants increased during the beginning of the COVID-19 pandemic. It was because of limited availability of domestic used disinfectant products causing people to blend them with other house cleaning products for personal hygiene, endangering children to exposure risk at home (Yasseen *et al.*, 2021). Daily calls to the United States Poison Center also significantly increased in early March 2020, with the highest percentage of exposure being on children ≤ 5 years old. It was because of not following the correct step according to the product's label and blending disinfectants with other chemical products (Chang *et al.*, 2020).

Other studies comparing disinfectant usage among health workers and other department workers with no relation to disinfectant use concluded that working on higher air acidity levels due to disinfectant use showed more watery eyes incidence (Casey *et al.*, 2017). In addition, a qualitative study in the COVID-19 task force in Bijai, Indonesia, found that all respondents experienced skin irritation, itchiness, and burning sensation because of skin contact with disinfectant liquid. Respondents used PPEs during the spraying disinfectant process but not during the substance mixing, so there was a possibility of exposure during the substance mixing process (Ahmad Zulfikri1 and 1, 2020).

CONCLUSION

Spraying disinfectants in public spaces helps reduce COVID-19 transmission through droplets. A spraying system is preferable and effective on curved surfaces, hard-to-reach areas inside or outside buildings, and large areas. Spraying disinfectants during the COVID-19 pandemics is also safe for humans. It is essential to choose the correct substances to dilute their concentration, a maximum of 200 ppm for chlorine-based disinfectants and 15% in concentration at approximately 250C in temperature for alcohol-based. In addition, individuals who perform spraying disinfectants must wear PPEs from the beginning of the process. Mixing disinfectant with other disinfectant products with different substance bases is dangerous. Spraying disinfectants cannot use for food ingredients (vegetables, fruits, and others) and the human body.

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