

Green Cleaning as a Tool in Combating COVID-19: A Content Validity Study for Malaysian Healthcare Facilities

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ABSTRACT

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Today's healthcare industry continues to advance its efforts on cleaning and disinfecting while also effectively addressing COVID-19 and other harmful organisms. However, excessive exposure to hazardous cleaning and disinfecting products can itself endanger health. Many of the ingredients used in cleaning products could be very detrimental to the health of the cleaning workers, patients, and the environment. Thus, green cleaning plays a vital role in combating COVID-19 while protecting human health and the environment. This study aims to determine the components of green cleaning for healthcare facilities in Malaysia and how green cleaning contributes to human health and prevents expected environmental consequences of conventional cleaning practices. A content validity study was conducted involving eight green cleaning expert panels. This paper is anticipated to provide an initial guideline for healthcare facilities in Malaysia in a structured way in practicing green cleaning during the pandemic.

Keywords: Green cleaning, Healthcare facilities, COVID-19

INTRODUCTION

The social and economic vitalities of a country, according to Samuelson (2017), are significantly effectuated by the roles played by healthcare institutions. The discerning functions of healthcare facilities in attending to injuries and managing disease outbreaks duly contribute to the assuagement of disasters. In light of the surge of emergency cases such as pestilent epidemics and pandemic diseases, healthcare facilities must revise their precedence and work approach to facilitate a more coordinated and organized response due to the complexity and evolutionary nature of such cases—field (WHO, 2014b). Hence, the role played by the health facilities above is highly decisive.

Besides that, the healthcare facility had become an even more crucial industry than ever before due to the COVID-19 pandemic. Hence the healthcare industry did not shut down like other industries. The speed and intensity of the COVID-19 pandemic had challenged the government to reshape healthcare facilities to facilities to reshape healthcare facilities dramatically. After almost two years of living with the COVID-19 pandemic, Malaysia can now look back and analyze the lesson learned from this challenging experience. Advanced infection control and prevention measures started during the pandemic are now a permanent part of the professional cleaning industry which can be accomplished by using safer, healthier, greener, and more sustainable products and procedures. The current crisis is an unprecedented wake-up call of how important cleaning health experts have proved instant, and health ex, parts have established it as the best defense mechanism against COVID-19. Routine cleaning and disinfection processes throughout hospitals are highly recommended to combat the virus transmission better.

Healthcare facilities are required to provide treatment for COVID-19 patients while at the same time not overlooking the needs of patients requiring treatment for other health matters. As such, the hospital industry needs to ensure that its equipment is of operational value and undergoes a thorough cleaning and disinfecting process (WHO, 2014a). This is highly important to safeguard patients and significantly reduce their chances of getting infections through healthcare-acquired pathogens. Thus, ensuring the environmental hygiene in healthcare facilities and reducing the concentration level of pathogens are considered to be effective in the prevention of healthcare-associated infections (HAIs) (Haque et al., 2020). This has led to more frequent chemicals and disinfectants to protect against COVID-19 pathogens. Unfortunately, chemical elements found in cleaning products are harmful to human beings and the environment. They consist of volatile organic compounds (VOCs) with high vapor pressure and low water solubility. This means the VOCs emitted as gases from these cleaning chemicals may have short- and long-term adverse health effects. Therefore, the needs arise to develop a cleaning program that delves into cleaning for healthy living without causing harm to the environment, namely green cleaning.

However, the fact is that conventional cleaning services may jeopardize the performance of the organization, while green cleaning is still one of the conservation considerations, which means that there are yet any guidelines or standards for the operation and maintenance of Malaysian healthcare facilities. In addition, research and practice of green cleaning are still unpopular in Malaysia due to the absence of green cleaning components. Without a clear, precise detail, the public will assume that green cleaning merely involves using environmentally friendly products. Hence, it will hinder even though some practitioners are well aware of the benefits of a strategically thought-out green cleaning program. Therefore, it is crucial to identify the components of green cleaning for healthcare facilities.

LITERATURE

The term 'cleaning' refers to the attempt to reduce the number of pathogens at the surface level to reach a target level deemed safe and fit for its purpose. Efficacious cleaning involves the following elements: clean water, cleaning products, and time. This paper addresses how green cleaning practices and products can evolve and co-exist with Malaysian healthcare facilities facing the Covid-19 pandemic. The COVID-19 pandemic has caused cleaning and disinfecting to take on a new level of importance and seriousness. COVID-19 has turned the expression 'cleaning for health' into reality. Many building owners and managers responded to COVID-19 by simply increasing cleaning frequencies. However, cleaning should be performed more thoroughly than in pre-COVID times to clean for health. In other words, they need thorough cleaning based on sound science. While cleaning is crucial in protecting health, this can only be accomplished by using scientifically proven cleaning solutions, products, and procedures. As claimed by the Father of Green Cleaning, Ashkin (2021), cleaning requires well-trained front-line cleaning workers to ensure that healthcare facilities can fulfill their missions.

In hindsight, when the pandemic began, other than social distancing and washing or sanitizing hands, cleaning was the only natural defense for our health. Covid-19 has a significant impact on every aspect of life and will have a considerable effect significantly impact both the healthcare and cleaning industries in the short and long term. Perhamost's most significant implications for cleaning are simply the fact that people are paying more attention to cleaning than ever before. Also, COVID-19 has highlighted that staff training must go beyond cleaning procedures and mandated training by the Occupational Safety and Health Administration (OSHA). This pandemic has demonstrated the need for a healthcare facility that can rapidly expand its intensive care services and has the physical infrastructure to curb the spread of a contagious, airborne virus.

This has indirectly brought our attention to the importance of a green cleaning process capable of deploying negative pressure to control the spread of airborne particles during intubation and other aerosol-generating procedures. Healthcare facilities are undoubtedly committed to ensuring their premises are properly cleaned and sanitized to safeguard their patients and staff from unwanted diseases

and infections. More so, extra precautions are being taken to curb the deadly spread of COVID-19. There is also a change in the way that healthcare facilities are operated. According to UNC Health, the Environmental Services team has doubled the number of sanitization processes in hospitals' public areas, including the emergency department, lobbies, waiting areas, public restrooms, and corridors. In addition, a specific site is no longer cleaned twice in an eight-hour shift but every two hours, which includes mopping, wiping up, cleaning restrooms, and wiping down chairs, counters, and other high-traffic areas. Cleaners are also required to clean patient rooms twice a day, emptying trash and replenishing cleaning supplies during the first cleaning and returning later to clean, sanitize, and disinfect the room. This further indicates that the healthcare cleaning team uses extra-strength disinfectants for sanitization under normal circumstances, especially with the pandemic today. Hence, they are conducting more frequent cleaning than ever before. According to the director of UNC Medical Center Infection Prevention, Emily Sickbert-Bennett, their organization suggests using clinically approved and EPA-approved disinfectants on all surfaces to extirpate potential pathogens in hospitals. They would be even more potent than what people usually use at home (Weber, Rutala, Miller, Huslage, & Sickbert-Bennett, 2010). She also claimed that COVID-19 is one of the easiest pathogens to disinfect. Thus, substantiating the claim that standard cleaning and disinfection protocols continue to apply during the pandemic but need to be conducted more often.

Nevertheless, it is crucial that cleaning and disinfection practices be closely monitored and that the responsible person be highly trained and use the proper PPE. Reasons for this are that workers (building maintenance workers, janitors, and housekeepers) who handle cleaning to ensure the cleanliness of the building are the most exposed to hazardous chemicals, especially if they are using an inappropriate quantity of products or if the products are prepared and misapplied. Disinfectants recommended for the COVID-19 often contain chemicals that can cause adverse health effects. Utilizing green cleaning products and process goes a long way in reducing concerns relating to matters of human health and environmental issues.

Based on several related literary works, eight green cleaning components were identified, and a theoretical framework has been formed and is shown in Table 1 below.

Table 1: Components of green cleaning

No	Green Cleaning Component	Description	Sources
1.	Planning	This component involves the development of a green cleaning policy; standard operating procedures (SOPs) for green cleaning; building-specific green cleaning plans that require different procedures for different types of buildings depending on their level of risk; and plans for powered equipment use and maintenance plan.	(New York University, 2019), (Zainol, 2016), (CDC and ICAN, 2019)
2.	Product and materials	The use of environmentally preferable products and materials is important to reduce the use of non-renewable resources and minimize exposure to hazardous chemicals. This component also includes non-powered cleaning tools, disposable janitorial paper products, trash bags; and hand soaps.	(New York University, 2019), (Zainol, 2016), (CDC and ICAN, 2019)
3.	Equipment	The cleaning equipment must come from environmentally preferable equipment that considers safeguard and ergonomic design; noise control; minimizing chemical usage; and minimizing propane emission. A good inventory management	(New York University, 2019), (UBC Custodial, 2012), (Zainol, 2016),

	and equipment maintenance plan are also important requirements in this component.	(UCONN, 2013)
4. Cleaning procedures	This component refers to a cleaning technique considered "green" which emphasizes more efficient procedures to reduce the overall dependence on chemicals and energy sources. The cleaning procedures involve cleaning techniques for the general environment and specific areas.	(New York University, 2019), (CDC, 2020), (Zainol, 2016), (CDC and ICAN, 2019)
5. Communication	Communication in green cleaning programs is important to allow workers to understand about the cleaning process. Accurate information regarding the organization's objectives, aspirations, and cleaning progress at each stage of execution should be clearly communicated to the project team and top executives, and understood by cleaning workers. This component includes the development of communication channels; description and information of the cleaning product used; and identification of building occupants with special needs or sensitivities.	(Zainol, 2016), (Fidelis et al., 2016)
6. Training	All cleaning workers must be well-trained. A proper training will not only safeguard humans and the environment from chemical hazards, but it will also save money by reducing expenditures associated with improper chemical usage and injuries caused by insufficient training. This includes initial training to introduce the procedures for proper cleaning, and how and when to use personal protective equipment (PPE); standard safety training; and site-specific training. Apart from that, a training record should be maintained and made available for each worker.	(New York University, 2019), (Zainol, 2016), (Fidelis et al., 2016)
7. Certification and labeling	The cleaning service provider must ensure that the cleaning program meets all the criteria provided by environmental-related standards and have to maintain compliance with the criteria. The environmental-related third-party standards provided by them will assist a company in setting up a management system that allows the company to meet their environmental-related goals. In essence, the standard should be thought of as a management framework that can be used to develop customer-centered, quality organizations.	(Zainol, 2016), (CIMS, 2018)
8. Custodial Effectiveness Assessment (CEA)	The effectiveness of the green cleaning program must be evaluated to define the level of cleanliness of buildings and the facility's appearance by conducting an audit.	(Zainol, 2016), (CDC and ICAN, 2019)

METHODOLOGY

The green cleaning components identified from the literature review were then used to conduct a content validity study to corroborate that the content of the green cleaning components is pertinent to healthcare facilities in Malaysia. In content validity, the selected panel of experts involved, namely green cleaning experts, have evaluated the instrument (questionnaire) and rated each item relevant to the domain of interest. In this study, the scale of 4-point Likert was used i.e., 1 = Not relevant; 2 = Somewhat relevant; 3 = Quite relevant; 4 = Very relevant

The degree of relevance for ratings 1 and 2 is considered "content invalid," while ratings 3 and 4 are considered "content valid." The minimum acceptable expert number for content validation is two. However, most recommendations propose a minimum of six experts and do not exceed ten (Yusoff, 2019). Studies also have recommended that to have sufficient control over the chance agreement, five to ten experts are required (Zainol, 2016; Zamanzadeh et al., 2015). Thus, eight-panel experts were selected based on their hands-on experience in green cleaning and their willingness to participate in this study. According to Polit & Beck (2006), the validity can be calculated using the formula in Figure 1 below. Therefore, this study estimates the truth of each green cleaning component by exerting the same procedure.

$$I - CVI = \frac{\text{Number of experts scoring an item with 3 and 4}}{\text{Total experts}}$$

$$pc = \left(\frac{[N!]}{[A! (N - A)!]} \right) \times 0.5^N$$

$$1k = \frac{I - CVI - pc}{1 - pc}$$

Figure 1: Formula for Content Validity

Where,

A: Number of experts scoring components requirements with a 3 and 4;

I-CVI: Content Validity Index for each item (green cleaning components);

pc: probability of random agreement;

k: modified kappa coefficient obtained by designing the relevant proportion of agreements where $k \leq 0.39$ = poor; $0.40 < k \leq 0.59$ = weak; $0.60 < k \leq 0.73$ = good; $k \geq 0.74$ = excellent.

Modified kappa value less than 0.60 is categorized as weak and poor and can be considered as a 'potentially problematic item' (PPI) and will be removed from the scale to ensure that the remaining items (green cleaning components) are genuinely relevant for this study.

RESULTS AND DISCUSSION

Content Validity

Table 2: Result of the Content Validity

Component	A	I-CVI	<i>pc</i>	<i>k</i>	Rating
Planning	8	1.00	0.004	1.00	Excellent
Products and materials	8	1.00	0.004	1.00	Excellent
Equipment	8	1.00	0.004	1.00	Excellent
Cleaning procedures	8	1.00	0.004	1.00	Excellent
Communication	8	1.00	0.004	1.00	Excellent
Training	8	1.00	0.004	1.00	Excellent
Certification and labeling	8	1.00	0.004	1.00	Excellent
Custodial Effectiveness Assessment (CEA)	8	1.00	0.004	1.00	Excellent

N= 8 samples

Source: (The Author, 2021)

Table 2 shows that all green cleaning components were rated as "Excellent" with an I-CVI value of 1.00. This means that all experts involved in this study have agreed that the green cleaning components listed in the questionnaire are relevant and appropriate to be implemented in Malaysian healthcare facilities. There is no "potentially problematic item" identified in this study.

Discussion

Proper planning at the start of the project life cycle has a beneficial impact on the project's final outcome (Jayawarna and Dissanayake, 2019; Naeem et al., 2018). With proper planning, future uncertainties can be substantially reduced where the healthcare system is involved. According to WHO, planning in the COVID-19 action plan framework consists of every phase, such as the prevention phase, control phase, early containment phase, late containment phase, mitigation phase, post-peak phase, and post-pandemic phase. Cleaning and disinfecting after every shift is now a standard operating procedure. Planning also involves the inclusion of SOPs to minimize variation and promote quality via consistent implementation or approach on healthcare facilities' part; furthermore, the tendency for miscommunication can be minimized. These plans and strategies aim to enable the healthcare facilities to respond more effectively to other emerging variants of the infectious virus of COVID-19.

Green cleaning products and materials are often deemed to be more natural and related to environmentally friendly products that reduce the health and environmental impact. It is vital to ensure that the cleaning products and materials used in hospitals are formulated to clean and disinfect and impede healthcare-associated infections that cause pathogens and other emerging new variants of COVID-19. The need to clean and disinfect is more critical now than ever before, which means patients' exposure to cleaners and disinfectants has increased substantially since early 2020. This situation can be detrimental to patients with respiratory complications such as COVID -19 since it is a respiratory disease that primarily affects the airways, including the lungs. In other words, COVID -19 patients have a range of respiratory problems from mild to critical, and the gases produced by the constant use of cleaning chemicals can have disastrous effects on their condition. Hence, it is essential to utilize green features in cleaning products without hindering their performance by reducing the use of non-renewable resources and curbing any exposure to hazardous chemicals. Ultimately, the use of environmentally friendly products and materials serves to cut costs and has other added values.

Choosing suitable and appropriate cleaning equipment is vital for an effective environmental cleaning program. The cleaning equipment used in any green cleaning program should be environmentally friendly. The healthcare facilities should ensure that such cleaning equipment meets the required standards. They should also consider essential characteristics to minimize patient disruption, such as safeguard and ergonomic design, ultra-low noise equipment, minimizing chemical usage, and minimizing propane emission. Powered equipment should be equipped with safety harnesses, such as casters or rubber bumpers, to reduce potential damage to building surfaces. Also, cleaning equipment can be expensive, and repairs can be costly and unnecessary. In recent studies, Ramli, Zawawi, Ariff, Kadir, & Zainol (2019) have reasserted that cleaning equipment should be energy and water-efficient to reduce maintenance and operation costs because the majority of facilities management expenditure is from cleaning, and it is at times like this that even more expenses are invested for cleaning operations. A logbook for all powered equipment must be maintained to record information such as purchase dates, maintenance history, and equipment information sheets. Poor inventory management can lead to excessive purchases, ineffective maintenance, and equipment breakdowns.

Since cleaning and disinfection can be the most critical aspects of a cleaning program, sufficient time should be allotted to describe the procedures and parameters. Cleaning and janitorial staff of health care facilities must use a thorough cleaning regime to ensure proper elimination of microbes and disease-like COVID -19 pathogens to ensure the safety of staff and, most importantly, patients. It is essential to have a straightforward procedure to use the cleaning product efficiently and reduce the waste of cleaning chemicals. In addition, the occupants of the building and the environment are at risk if the handling of chemicals is careless. Identifying high-touch surface areas and items within specific patient care areas is also necessary when developing cleaning procedures to prevent further transmission of COVID-19, as these areas are vulnerable to high patient exposure.

Effective communication serves as the basis for planning. Health facility management primarily has the responsibility to develop and maintain effective communication within the organization. In a green cleaning program, two-way communication is critical to ensure the effectiveness and efficiency of the green cleaning program, as miscommunication can have dire consequences. A communication plan should be developed for all parties, especially for cleaning workers involved in a green cleaning program. The project will usually include communication channels, notification of cleaning products, building occupants with special needs, and the sensitivity to ensure that those with special needs are protected from any health issues. Developing communication channels to enable incidents to be reported, suggestions and comments to be made, and user feedback to be quickly reviewed to identify undiscovered problem areas. A communication plan also plays a vital role in management as it helps get every worker on the same page and ensures that all staffs and cleaning workers are aware of the plan (Zainol, 2016; Fidelis et al., 2016).

COVID-19 infection control training is very crucial for cleaning workers in all settings. It should cover the fundamentals of infection prevention and control for COVID-19. Providing proper training is indeed vital to the success of the green cleaning program. However, without ample and appropriate training, the workers tend to fall back on past practices, which hinders the objectives of such programs. The training is not only limited to the medical staff who use the equipment. After setting the proper procedures and policies, appropriate cleaning procedures must be taught and exposed to the cleaning team. Training should include chemical and equipment safety issues, adequate storage of products, and disposal of waste materials. In emphasizing, Peters et al. (2018) claimed that even the best and most sophisticated cleaning substance and the best cleaning staff would be rendered useless if ineffective against a particular pathogen.

In the green cleaning program, being certified will acknowledge people on products and what chemicals to look for in them. The certification proves that such an organization actively practices sustainable procurement and has sound policies, processes, and procedures that are monitored and verified by procurement bodies (UNOPS, 2013). Meanwhile, the idea of labelling green cleaning programs is an important initiative to address the issue of environmental deterioration while at the same

time urging more countries and regions to delve into sustainable development for the sake of protecting the environment. Green labelled products on the market make them appear “greener” or more environment-friendly, setting them apart from other products on the market. It follows that green label information can significantly impact consumer purchase intention and increase consumer awareness of buying green products. However, consumers need to be cautious in interpreting vague or general claims on products such as "eco-friendly," "eco-safe," or "green" fields (EPA, 2021). Therefore, consumers should be aware that certification and labelling should meet all the criteria of the environmental standard. In this context, third-party audits are carried out to ensure that the cleaning products and services used by cleaning service providers provide documentation to prove that their services meet the underlined criteria. Moreover, certified products and services should be monitored to ensure that cleaning service providers comply with the standards concerning the use of products and services offered.

Custodial Effectiveness Assessment (CEA) is essential to indicate a building’s level of cleanliness. According to Sullens (2013), CEA has the role of protecting building occupants and maintenance personnel from being exposed to potentially hazardous chemicals and biological contaminants through the auditing of cleaning processes and procedures. The level of cleanliness might vary for different people. By setting a standard cleaning deck, custodians can focus more on meeting requirements by adjusting their work activities. In green cleaning, CEA has the responsibility to reduce the levels of chemical, biological, and particulate contaminants that may endanger human health, building finishes and systems, and the environment through effective cleaning procedures. There is only one crucial element that should be considered for this component: evaluating the effectiveness of the green cleaning program. The novelty is that conducting an audit on the program is to determine the facility's appearance level. Audits on the areas are reiterated until the required satisfaction level is achieved. Such inspection must verify that specified strategies have been implemented while at the same time identifying areas that need improvement. The CEA is important to ensure that green cleaning procedures are carried out following best practices and facility policy.

CONCLUSION

The conceptual framework can provide a guideline to support improved infection prevention and control in health settings while going green. The understanding of the direct connection between green cleaning and health will continue long after COVID-19 is addressed, as well as the power of the consumer to choose products and processes that can minimize the negative impacts on health and the environment compared to other products with the same purpose. Every healthcare facility and household consumer should strive to be a green consumer.

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Author A Kamaruddin wrote the manuscript in consultation and supervision with author N N Zainol who conceived the original idea. Meanwhile, authors M A Sulaiman, A S Sukereman, and H A Hashim helped supervise the study. All authors discussed the results and contributed to the final manuscript by providing critical feedback and helping shape the research, analysis, and manuscript. Finally, the authors declare that there is no conflict of interest.

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