SYSTEMATIC APPLICATION OF GREEN CLEANING IN SRI LANKAN HEALTHCARE SECTOR

A.K.N.E. Rathnasiri*, Pournima Sridarran, Biyanka Jayangani Ekanayake
Department of Building Economics, University of Moratuwa, Sri Lanka

Abstract

Extensive use of complex cleaning chemicals and disinfectants in the healthcare industry has raised concern over the effectiveness of conventional cleaning in creating a safe and healthy environment. The increasing rate of adverse respiratory and dermatological illnesses among healthcare custodians has emerged the need for effective yet safer cleaning alternatives. Green cleaning was introduced in the 1980s as a substitution for conventional cleaning. Green cleaning denotes methods and products of cleaning, which incorporated environmental friendly ingredients designed to preserve human health and environmental quality.
Even though there is rapid adoption of green cleaning in developed countries, developing countries seem to fall behind in shifting to green cleaning. However, ad hoc green cleaning practices are incorporating in the Sri Lankan healthcare sector. This research focuses on investigating the systematic application of green cleaning in the Sri Lankan healthcare sector. A qualitative research approach has been undertaken to pursue the research aim. A comprehensive literature synthesis was carried out to review the green cleaning concept. Expert interviews were conducted among cleaning related personals of both private and government healthcare facilities and the collected data was analysed through content analysis techniques.

It was affirmed that green cleaning ad hoc practices are higher compared to the systematic practices. This reveals the possibility of integrating green cleaning into Sri Lankan healthcare sector. However, the need for a collaborative effort from the green cleaning stakeholders was proven. Green cleaning strategies encompassing educational, management, government and market conditions are identified. Improving the awareness, top management commitment, government policies and regulations, improved marketing and custodian's positive attitudes are some identified strategies that could be applied to overcome the barriers.

Keywords: Green cleaning, Conventional cleaning, Healthcare sector, environmental impact, health impact, toxicity

* Corresponding Author: A.K.N.E.Rathnasiri; E-mail- nimali.aththanagalla@gmail.com

1.0 Introduction

Among the support services of any organization, cleaning is recognized as a main service and the awareness of this service is significant for effective building operation (Klungseth & Olsson, 2013). Cleaning is compulsory in ensuring a healthy environment as well as accounted to be a costly service (Darly & Pitt, 2012; Klungseth & Ollson, 2013). According to Quinn et al., (2015) cleaning is critical in the healthcare industry and hospitals and other related healthcare service providers striving hard to prevent Healthcare-Associated Infections (HAI) through better cleaning. In hospital cleaning, disinfectants play a vital role as the common cleaning product while carrying the hazardous properties within them (Espinoza, Geiger, & Everson, 2011). At the same time, the increase need of handling cleaning disinfectants intensifies the exposure and the risk of health effects including respiratory illness (Quinn, et al., 2015). It is a well-known factor that healthcare workers are frequent victims of asthma and related symptoms, which is the result of the association of cleaning and disinfecting products (Saito, et al., 2015). Due to the elevated risk of respiratory effects on healthcare workers, the need for a safer alternative has been gradually increased (Dumas et al., 2017: Dancer, 2016). The adverse effect on the environment has also encouraged the products, which has a lesser impact on the biological system (Dancer S. , 2011).

As a solution for the increasing health effects of exposure to cleaning and disinfecting products, hospitals seeking less toxic, often called green cleaning and disinfecting products and methods (Quinn, et al., 2015). Most of the owners, employers and building managers are shifting towards green cleaning chemicals with the expectation of providing a safer environment for the workers (OSHA/NIOSH Infosheet, 2012). Green cleaning denotes to methods and products of cleaning, which incorporated environmentally friendly ingredients designed to preserve human health and environmental quality (Sabharwal, 2015). Green cleaning is interrelated to the sustainability concept (Corbett, Wagner , & Esbensen , 2017). This concept considered as a novel and encouraging approach, which aims to reduce the negative impact on human and environment caused by the cleaning (Quan, Joseph, & Jelen, 2011). Published definition for the green cleaning is yet to be discovered (Spruce, 2017: Quinn et al., 2015: Quan et al., 2011). However, green cleaning refers to the avoidance of chemically reactive toxins (Sabharwal, 2015). The green word stands not only for the chemical composition and attributes of the products but also for any method of overall performance improvement process of cleaning, which results in the reduction of the negative impact on the health of the human and environment (Quan et al., 2011).

However, Atamamen et al., (2016) pointed out that green cleaning adoption in the healthcare sector is slow in developing countries compared to the developed countries. In Sri Lankan context studies have been conducted prioritizing to the quality improvements yet concern regarding health and safety practices seems to attract a less focus. Even though the green cleaning concept and its various adaptations relating to the healthcare sector have been broadly discussed in the global context, it is not yet popularized in Sri Lanka and no literature found on the local context. Nevertheless, ad hoc practices of green cleaning in the Sri Lankan healthcare industry are present and this research investigates the systematic application of green cleaning in the Sri Lankan healthcare industry.

1.1 Green Cleaning

Green cleaning generally means a systematic environment friendly cleaning approach, which not only includes the use of green products according to the chemical composition and also other attributes (Quan et al., 2011). It commonly refers to environmental cleaning approaches aims to

reduce harmful effects of cleaning on human health and environment while maintaining or improving the cleanliness of the healthcare environment for infection prevention (Environmental Protection Agency [EPA], 2010). In addition, EPA mentioned that selection of green cleaners, use of safer alternative cleaning methods and changes in building design and operations as the approaches of green cleaning. Moreover, green products are often carrying the properties of limited exposure to the product using techniques such as better automatic dilution systems, recyclable or already recycled packaging and reduced energy usage for transportation which used concentrates along with the favourable ingredients (Espinoza et al., 2011). The environmentally friendly manufacturing, packaging, and distribution of cleaning products are also referred under green cleaning (Sabharwal, 2015). According to Quan et al., (2011), the selection of surface materials that are easier to clean, performance improvement of cleaning staff and microfiber usage can be mentioned as green cleaning practices. Table 1 list out the categories of green cleaning.

Table 7: Green cleaning categories
Adopted from: (Quan et al., 2011)

Selection of cleaning products	Operational Change	Building Design
- Green cleaners - Cleaning tools/equipment which use less water and chemicals - Minimal number of chemical types	- Appropriate level of cleanliness - Application & Dispensing methods - Use of flourescent marker	- Interior design that reduces the need for cleaning or facilitates cleaning - layout that makes housekeeping more efficient

1.2 Green cleaning practices in healthcare sector

The healthcare industry reputed as a main natural resource user and a waste and environmental pollution generator (Chevan & Copeland, 2013). Moreover, the authors stated that this reason has emerged the need for healthcare reform to match environmental sustainability. Table 2 lists out the green cleaning practices that can be applied to a healthcare facility.

Table 8: *Green cleaning practices in healthcare sector*
Adapted from: (Markkanen, Quinn, Galligan, & Bello, 2009)

Selection of Cleaning Products	Operational Changes	Building Design
• Microfiber product usage • Selection of surface material that easy to clean & maintain • Selection of green chemicals & products • Selection of products with less packages	• Provide private patient rooms to prevent HAI while protecting the patient • Prevention of water leakages through maintenance to reduce fungal formation & borne pathogen infections • Waste reduction & Recycling programs	• Designing the HVAC system to support the removing of air borne contaminants • Designing of rooms, floors, bathrooms & toilets to clean with lesser amount of chemicals

Among the green cleaning practices, adopting less harsh chemicals has identified as the common method and also the selection of microfiber mops and cleaning cloths has been adopted due to the properties of water conservation and less waste generation (Quan et al., 2011). Further authors explained that usage of efficient floor scrubbing machines to save time and labour, usage of metered dispensers for the proper dilution, changing the production application methods to safer methods (e.g.: squeeze chemicals from a bottle with a pour spout onto a cleaning cloth, compared to the conventional practice of spraying chemicals onto surfaces) has adopted by the healthcare organizations as green cleaning methods. Apart from antimicrobial surfaces, automated decontamination devices and monitoring strategies for housekeeping staff can be named as novel practices of green cleaning (Dancer S. J., 2016).

1.3 Critical Success Factors (CSF) of green cleaning

Proper awareness, proper training, and knowledge on green cleaning and the top management commitment are accounted as the main critical success factors while proper communication among the stakeholders, custodial participation, appointing a green cleaning project team followed close by (Atamamen, Mohammed, Abdullah, Asmoni, & Hamid, 2016). The external CSF has been identified as the availability of environmentally sensitive vendors and a supportive legal background. The following table presents the enablers and barriers of green cleaning identified through the literature. Table 3 compile the enablers and barriers of green cleaning.

Table 9: Enablers and Barriers of Green Cleaning

Literature Source	Enablers of Green cleaning	Barriers of Green cleaning
(Senier, Mayer, Brown, & Frosch, 2007)	Supportive top management, Conducting pilot studies, Committed employees, Simple purchasing, Custodial education, Planning & Evaluation	Lack of equipment, Poor quality training programs, Lesser participation in decision making
(Quan et al., 2011)	Top management immense support, Staff training, Internal multidisciplinary team on sustainable concepts	Janitorial resistance, Lack of green product availability
(Xu, 2012)	N/A	Janitorial Resistance, Lack of funds, Training issues with new techniques
(Simcox, Wakai, Welsh, Westinghouse, & Morse, 2013)	N/A	Lack of effectiveness of some green cleaners, Lack of participant, Expensive green cleaning products in decision making, Inadequate training

1.4 Benefits of Green Cleaning Practices

Intuitive evidence has identified general benefits of green cleaning as lower infection rates, reduced number of complaints from the occupants and water and chemical conservation (Quan

et al., 2011). Decreased health and environmental impacts, reduced employee turnover and absenteeism, reduced costs related to workplace illnesses, reduced insurance and legal costs, improved indoor environmental conditions, quality stay of building occupants and safe workplace for employees has also identified as added benefits of the green cleaning (Atamamen et al., 2016). It has been proven that adoption of green cleaning improves indoor air quality, decrease work-related illnesses and support the organizations to meet sustainability goals (Xu, 2012). The usage of automated dilution systems reduces the over dilution or lesser dilution associated with manual practices hence protect the custodian from high concentrations to the chemicals (Boyce, 2016). A relatively new method of using microfiber, ultra-micro fiber cloths for applying disinfection has shown increased efficiency compared to the traditional cotton cloth or mop (Trajtman, Manickam, & Alfa, 2015). Scientific evidence supports that the majority of the greener alternatives degrade into harmless components (Dancer S. , 2011). Green cleaning techniques preserve human and environmental health and improve quality by avoiding chemically reactive toxins (Sabharwal, 2015). Green cleaning chemicals contributing to provide a safer environment for workers, physicians, visitors and most importantly vulnerable patients (Simcox, Wakai, Welsh, Westinghouse, & Morse, 2013).

2.0 Research Method

Qualitative research approach has been adopted to conduct the research. The most distinguishing feature of this approach is that it allows the researcher to delve into the research problem from the study partners' perspective and based on that, fathom the interpretations and opinions of them (Hennink, Hutter, & Bailey, 2010). The how natured research question and the subjective nature of the required data supported the selection of qualitative approach. Even though green cleaning concept has been evolving since 1980 s in the global context, green cleaning accounted as a novel concept in Sri Lanka. Hence drawing a large sample of respondents acted as a limitation of the research.

Twelve (12) semi-structured interviews were carried out among industry practitioners of the healthcare industry who has had experience in the cleaning sector equivalent or more than five years. Target interviewees were selected based on their direct hands-on involvement with cleaning. Without limiting to a particular sector both private and government organisations were selected and interviewed professionals including facilities managers, executive housekeepers, supervisors as well as a green cleaning supplier. Hsieh and Shannon (2005) discussed that content analysis provides subjective interpretations to the collected data using systematic coding and patterns and has been preferred by the academics to analyse text data. Hence NVivo 12 software was used for the content analysis along with the manual content analysis.

3.0 Analysis and Discussion

3.1 Current cleaning practices of Sri Lankan healthcare sector

In Sri Lankan healthcare industry, the method of general cleaning can be mentioned as almost identical since all the organisations follow similar procedures. The only contrasting factors identified were the type of cleaning chemical used and the frequency of the activities performed. Even though the chemical type is shown to be different, the incorporation of a minimum of five types of cleaning chemicals and detergents into the cleaning activities was evident. Table 4 presents the current methods of general cleaning in Sri Lanka healthcare sector.

Table 10: Current methods of cleaning in Sri Lankan healthcare sector

Cleaning task		**Method of cleaning**
Floor cleaning		Wet mopping using a chemical solution.
Window cleaning		Spraying the chemical solution to the window and wiping down.
Bathroom cleaning	**Mirror**	Spraying the cleaning solution to the mirror and wiping down
	Wash basin	Pouring the detergent into washbasin and brush
	Toilet Bowl	Pouring the chemical into toilet bowl and leave it for few minutes and brushing and cleaning with water.

Even though above-mentioned practices were regular in Sri Lankan healthcare sector, the number of complaints received from the custodians and building occupants regarding Skin irritations, asthma situations, allergies, rashes and chemical burns stressed that chemical exposure level and thus, vulnerability to respiratory and other related illnesses is high in the local context. The environmental impact of the current cleaning practices was investigated and most mentioned factors was water pollution, reduction of the ground water quality, air contamination and impact on the wild and aquatic life. Wastewater treatment was the most popular method adopted by Sri Lankan healthcare sector to minimise or to rectify the above- said issues according to interviewee A, B, D and G. However H organisation does not own a water treatment plant and releasing the contaminated water directly to the municipal drainage lines which raises concern over many levels. Per Interviewee B "*current cleaning practices definitely accounted for environmental impact. The smell of the chemical indicates that chemical particles are present in the breathing air. Water regularly gets contaminated by excessive usage of chemicals. Even if they get treated, a 100% guarantee of zero water contamination cannot be given. These effects will not be visible immediately. However, in the long run, they can emerge as new threats*." The need for more health and environmentally conscious cleaning approach was followed by that statement.

The effectiveness of the current cleaning practices was discussed and all interviewees agreed on the efficacy in preventing HAI. Nevertheless, interviewee B stated that "effectively does not mean there isn't a better way to improve" and this statement was agreed by most interviewees which expressed that there is a need for change in current cleaning practices. It would appear to suggest that current cleaning practices contain gaps that require modernization and improvement regardless of managing the daily operations.

3.1.1. Applicability of Green Cleaning

Since green cleaning accounted to be a novel concept in developing countries, examining the awareness level was a major part of the study. To examine the current level of awareness of green cleaning among the industry practitioners and to identify the applications implemented by the practitioners, it was explored whether organizations were aware of the concept and currently practicing or willing to practice the green cleaning concept in the future. Table 5 present the awareness level of the green cleaning concept and the level of practice in selected interviewees organisations.

Table 11: Green cleaning awareness and practices level in Sri Lankan Healthcare sector

Interviewee Code	Organization	Aware of GC	Practices GC	
			Systematic practices	Ad hoc practices
A	Private hospital	X	X	√
B	Private hospital	√	√	X
C	Private hospital	√	√	X
D	Private hospital	√	X	X
E	Private hospital	X	X	√
F	Private hospital	X	X	√
G	Private hospital	X	X	√
H	Private hospital	X	X	√
I	Government hospital	X	X	X
J	Government Hospital	X	X	X
K	Government Hospital	X	X	X

The results of table 1 show that most of the professionals were unaware of the green cleaning concept and significantly less number of professionals were familiar with the green cleaning concept and the term. Most importantly among the interviewees who were aware of the concept, a handful number of organisations practices green cleaning. Without the term "green cleaning" the recent changes done to the cleaning services were questioned and analysed. The changes identified in the Sri Lankan healthcare context related to cleaning were compared with the green cleaning applications found from the global context and the following practices matched with the green nature changes as highlighted by the empirical researchers. Table 6 display the recent changes attributed to green cleaning in healthcare organisations.

Table 12: Recent changes attributed to green cleaning in healthcare organisations

Change Category			
Changes attributed to products	**Changes attributed to operation**	**Changes attributed to building design**	**Changes attributed to safe practices**
• Changed to non-threatening chemicals • Changed to Bio degradable chemicals • Cotton clothes replaced to	• Started waste recycling • Integration of housekeeping activities and maintenance activities • Water conservation	• None	• Change the PPE for better standard

Change Category			
Changes attributed to products	**Changes attributed to operation**	**Changes attributed to building design**	**Changes attributed to safe practices**
microfiber cloths • conventional mops changed to microfiber mops • Stopped using strong chemicals • Shifted to environmental friendly air fresheners	• Started staff training programs to train on hazardous chemicals • Refining the cleaning schedule		

The results indicate that even though the green cleaning term is not present, ad hoc practices of green cleaning have been adopted by healthcare organizations. As mentioned by Bello et al. (2009), the selection of green cleaners, the use of safer alternative cleaning methods and changes in building design and operations comes under green cleaning practices. Under these three main categories, several forms of applications have identified through the literature synthesis. Compared to the global context, it is evident that in the Sri Lankan healthcare sector the majority of the practitioners adopted only cleaning product changes and few operational changes. No interviewed organization has considered including features to building design to support cleaning as a green cleaning method. The identified most common practice was shifting from conventional cleaning chemicals to biodegradable cleaning products. Biodegradable cleaning products are known for characteristics of minimum health impact and minimal environmental impact. Water conservation and reduced chemical usage were discussed under operational changes of green cleaning. Metering systems of chemical dilution has mentioned under the green cleaning practices. Nevertheless, only E organization performs the chemical dilution through a dosing pipe, which strongly suggests that the Sri Lankan healthcare industry is fallen behind in adopting new technologies for the cleaning segment. According to the literature findings, from the stage of building design, material selection, green cleaning product selection, recyclable packaging, waste recycling, and water conservation and reducing unnecessary cleaning requirements offers a wide range of green cleaning applications. Despite the number of applications, the Sri Lankan healthcare sector seems to be limited to a few applications. The analysis of the recent cleaning changes indicates that the level of green cleaning practitioners has increased with the identification of ad hoc practices. The evidence supports that ad hoc practices are higher than the systematic application in the Sri Lankan healthcare sector.

Table 5 exhibit that combining both systematic and ad hoc practitioners, the majority of the interviewed organisations were proven to be practicing green cleaning. The lesser number of non-practitioners compared to the practitioners indicates that a considerable application level of green cleaning can be seen in Sri Lanka even without a systematic approach. However, there is a need to popularize green cleaning among the practitioners in a systematic way to support the best and most up to date practices.

3.2 CSF of green cleaning in Sri Lankan healthcare sector

The CSF of green cleaning were identified through the literature synthesis and the identified factors were presented to the respondents to identify the CSF which is applied to the Sri Lankan context.

Critical Success Factors of Green Cleaning

Name	Files	References
Critical Success Factors of Green Cleaning	12	76
Awareness, Training and Education	12	12
Top Management Commitment	10	10
GC Legislation and Guidelines	10	10
Custodial Participation and Acceptance	8	8
Financial Capacity	8	8
Knowledgeable Environmentally Aware Vendor	8	8
GC Service Provider	4	4
Pilot Study	4	4
Communication Strategies	3	3
GC Awards and Incentives	3	3
GC Project Team	3	3
Review and Improvement	3	3

Figure 17: CSF of green cleaning in Sri Lankan healthcare sector

Figure 1 presents the code structure for identified CSF of green cleaning in Sri Lankan healthcare sector. Awareness, training, and education were mentioned by all interviewees. The majority of the interviewees have mentioned green cleaning legislation and guidelines, top management commitment, custodial participation and acceptance, financial capacity and knowledgeable environmentally aware vendor as CSF of green cleaning applicable to Sri Lanka. Few interviewees have identified the availability of green cleaning providers and conducting pilot studies as success factors while the least mentioned factors were the communication strategies, green cleaning awards, and incentives, establishing a green cleaning project team and review and improvement. Proper awareness from all the community members including management personals, workers, suppliers, government, students and researchers were highlighted to successfully popularize the true meaning of the green cleaning. Government influence on supporting safe practices was also discussed and simultaneously it was highlighted that policies and guidelines imposed by the government make the concept concrete. As decision-makers, top management and their commitment to bring this green cleaning concept into play were considered to be compulsory in organizations. Since the initial cost of green cleaning slightly accounted for higher capital compared to the conventional cleaning, having a financial capacity to gradually shift to the safer alternative was discussed as a CSF. However interviewee B and L argued that compared to the other operational cost of a healthcare facility cleaning expenses are lower and benefits always outweigh the cost. Custodial participation and acceptance have identified as the second most important success factor by the respondents. The criticality was further elaborated since workers are the party who directly involve with cleaning, their acceptance, and positive responses are more important in the successful delivery of green cleaning otherwise it will be a futile attempt. The knowledgeable and environmentally aware vendor also received attention from respondents and according to interviewees, it was heavily depending on the supplier's ability to influence the

management decision strongly. Aside from the discussed success factors, conducting a pilot study and communication strategies were also discussed.

3.3 Barriers to apply green cleaning in Sri Lankan healthcare sector

The barriers which hindered the green cleaning implementation in the healthcare sector were identified to capture the bigger picture of green cleaning.

Barriers to Apply Green Cleaning in Sri Lanka Health Sector

Name	Files	References
Barriers to Apply Green Cleaning in Sri Lanka Health Sector	12	67
Lack of awareness	12	12
Lack of top management commitment	7	7
Lack of technical advancement in the country	6	6
Lack of involvement from government	6	6
Lack of resources	5	5
Risk of using green cleaning chemicals	5	5
Poor attitudes of the workers	5	5
Low level of quality of cleaning	5	5
Expensive green cleaning products	4	4
The less priority given to the innovations	4	4
Lack of competitive market	3	3
Lesser number of complaints receives	2	2
Lack of third party certification for the products	2	2
Comparativelty small chemical industry	1	1

Figure 18: Barriers to apply green cleaning in Sri Lankan healthcare sector

Figure 2 present the code structure for identified barriers of green cleaning. The lack of awareness was the most highlighted barrier. In addition to that lack of top management commitment, lack of involvement from government and lack of technological advancement in the country were identified as factors that hindered the adaptability of green cleaning in the Sri Lankan healthcare sector. Poor attitudes and support from the workers has also reduced the spread of green cleaning since the restrain generating from the hands-on people affect the adoption of new concepts. The absence of quality measures and concerns regarding cleaning and lack of resources also acted as barriers to green cleaning. Lack of third party certification, lesser complaints received, lack of competitive market and poor attention to innovation have also recognized as impediments to the systematic application of green cleaning. The comparatively small chemical industry in Sri Lanka has also been noticed to act as a barrier as well as a reason for the lesser attention received for green chemicals.

It was evident that without knowledge of the concept it is difficult to initiate the concept in the healthcare sector. The second most commented barrier was a lack of top management commitment. Lack of interest of management personals as decision-makers act as a barrier in implementing green cleaning at the organization level. The lack of involvement from the government was discussed thirdly as one of the barriers. The term "involvement" was explained as involvement in educating the community on green cleaning, creating policies and regulations, increased attention to minimize the environmental impact of cleaning chemicals and initiating the green cleaning adoption in government organizations. The inadequate level of innovations and

adaptation of new technologies of Sri Lanka were too discussed as barriers. As a developing country, Sri Lanka seems to delve behind in adopting new technologies. Compared to the literature, this barrier also seemed to be unique to the Sri Lankan context. Poor attitudes of the custodians were discussed as one of the barriers. Besides, the lack of attention to the quality of cleaning and the risk of using green cleaning was discussed under barriers of green cleaning. Interviewee D stated that experimenting with new cleaning technology is a high- risk activity in healthcare sector in the event of an HAI breakdown. Custodians tend to account for diverse personalities since their recruitment criteria to be met were fairly simple and scrutinize only limited areas. Often the wellbeing of the custodians was neglected by themselves and occupational health and safety have been rarely considered. Thus, custodians' unwillingness to adapt to new concepts could have a colossal impact on adopting green cleaning. In addition, the lack of competitive market and the expensiveness of the products are highlighted as barriers to overcome the reluctant adoption of green cleaning

3.4 Strategies to apply systematic green cleaning in Sri Lankan healthcare sector

The barriers identified demonstrates that several strategies require to successfully implement green cleaning in Sri Lankan healthcare sector. With the suggestions of the interviewees and the careful analysis, the identified strategies were categorized under several categories. The defined categories were educational strategies, management strategies, product improvement strategies, market strategies, and government influence strategies.

Strategies to Apply Green Cleaning in Sri Lanka Healthcare Sector

Name	Files	References
Strategies to Apply Green Cleaning in Sri Lanka Healthcare Sector	12	73
Educational	9	17
Conduct awareness program	9	9
Incorporation of GC into educational system	4	4
Top management education	4	4
Product improvement	9	16
Availability of Quality product	8	8
Third party certification	5	6
Availability of Effective products	2	2
Government Influence	9	15
Policies & Regulations	9	9
Initiate the GC adoption in Gov. organizations	4	4
Tax releasing & other initiatives	2	2
Market conditions	8	12
Knowledgeable vendors	3	3
Convenient buying	3	3
Low price levels	3	3
Increased marketing	3	3
Management Support	7	13
Improved attitudes of workers	6	6
Improved concern over quality than the price	5	5
Janitorial acceptance	2	2

Figure 19: Code structure for strategies of green cleaning

Figure 19 presents the coding structure for strategies of applying green cleaning.

3.4.1 Conduct awareness program

Conducting proper awareness programs among the cleaning practitioners is identified as a necessity. The cleaning practitioners included all the stakeholders of green cleaning including management-level workers. By educating the management personals, the effort requires to incorporate green cleaning into healthcare organizations will be significantly reduced. Arranging training programs for the custodians come under conducting awareness programs. The lack of awareness of the health effects of conventional cleaning was evident from the responses received from janitors as well as the executive level respondents. Interviewees highlighted the need to integrate the value of green cleaning and associated benefits to the educational system to ensure that the young population has a firm grasp on the fundamentals of green cleaning which will influence them to adapt these safer alternatives in the future. By conducting awareness programs among ad hoc practitioners, it will provide a solid visualization of the green cleaning practices and will motivate them to convert to the next step. In addition to that, more choices of green cleaning practices can offer to the community than the popular belief of shifting to green chemicals as the only method of green cleaning.

3.4.2. Government policies & regulations

The government's involvement in permeating new concepts, practices in a country has proven to be essential. Understanding the concept and its necessity to society, the government can develop provisions to support the green concept. Developing policies to establish boundaries for acceptable behaviour of the custodians and guidelines for best practices in green cleaning can create a supportive environment for the green cleaning implementation. The developed guidelines and polices offer clear communication to the industry practitioners and will direct them towards safer practices. One of the highlighted facts was establishing a national policy on cleaning in the healthcare sector which will in return unified the cleaning and improve the quality of the service.

Due to the poor quality products and marketing strategies currently used to increase the sales by the sellers, customers are more conscious of accepting a green product without a third-party certification. If the government approvals are presents people tend to believe that to be the best option, not a profit-making way introduced by the suppliers in countries like Sri Lanka. Interviewees suggest that government institutes that overlook the health and environmental safety should heed the pressing matters. Government initiation of adopting green cleaning can encourage the private sector to follow. The evidence suggests that compared to the private sector, the government has shown less concern over green cleaning. Apart from that providing awards and incentives such as releasing taxes to the green cleaning suppliers and users can accelerate the adoption of green cleaning in the Sri Lankan healthcare sector.

3.4.3 Availability of Quality product

The availability of quality products in the market provides ease of purchase to the customer with increased value for money. This approach will encourage the customers to try a new concept. The responses from the interviewees and the comments of the supplier indicate that green cleaning products are difficult to purchase directly from the market in Sri Lanka. Oftentimes they are offered as a service by the suppliers. The reason for the somewhat lack of availability of products

in the available market was explained as without proper instruction and training the products will not be effective and get wasted. This causes damages to the emerging industry. Most of the new customers expect greater results from the product the moment they apply it. Without proper knowledge of how to apply, what amount and the reaction times, customers are getting frustrated due to lack of immediate results. This is another chain effect of lack of awareness of the green cleaning concepts and methods. The performance of the green cleaning products sometimes requires more time and effort to apply. Impatience can damage the existing market. With proper awareness programs and the training programs, products can be effectively sold in the market with achieving profit. Nevertheless, most of the time organizations purchase their cleaning products in bulk. Supplying green cleaning products as a service is important.

3.4.4. Improved attitudes of workers

The resounding factor exposed from the responses of the custodians was, the lack of awareness on the negative impact of current cleaning chemicals. The impact of exposure has never been accounted for by the custodians while performing the duties. Even though complaints have been made on health issues, those seem not directed towards the job activities performed by the custodians. A root cause analysis would suggest otherwise. The lack of knowledge and understanding has made the custodians more vulnerable to unfavorable conditions. If the worker to express their concern over health issues and to demand safe practices, organizations will compel to look for alternatives. However according to interviewees, in Sri Lanka, cleaning workers less willing to make complaints since they are under the influence of losing the job as cleaning workers job has considered and treated as a low-level occupation in Sri Lankan context. The significant matter should consider by the management is that the service of the custodians is compulsory in a healthcare facility to create a safe and healthy environment. Further participation in the training programs, acceptance of safer practices, usage of proper PPE and following the proper procedures introduced by the organizations is necessary to implement green cleaning. Custodial participation and acceptance have a major impact on going green.

3.4.5. Increased marketing of green cleaning

Since green cleaning is yet to be popular in Sri Lanka, according to the respondents, suppliers should market their products focusing on the values and benefits of green cleaning to attract consumers to green cleaning concept and products. Nevertheless, from the suppliers' point of view, extensive marketing can send the consumers and suppliers through a frenzy where the original purpose of incorporating green cleaning practices into organizations and households will be demean. Interviewees pointed out that fear of risks associated with converting towards green cleaning can be minimized through a valid third-party certificate. It will not only act as a risk-sharing mechanism it will ensure the quality and the standards of the products as well.

Apart from the above discussed strategies, incorporation of green cleaning concept into educational system, educating the management personals and supporting true environmental conscious suppliers were identified. Providing initiatives such as tax releasing, recognition to both green cleaning user and the vendor would encourage the parties in embracing this novel practice. Third party certification from a recognized organization and supplementing the quality products in available market has also been discussed as strategies to apply for green cleaning in Sri Lankan healthcare sector. Last but not least, janitorial acceptance has a major impact on adopting green cleaning in an orgnisation.

4.0 Conclusion

The rising adverse impact of conventional cleaning practices on humans as well as the environment has emerged the need for a safer and effective alternative. It was evident that Sri Lankan healthcare sector is gradually evolving towards green cleaning with the influence of health and environmental consideration factors. Multiple CSF of green cleaning were identified and prevailing barriers for implementing this novel concept were derived to comprehend the current situation. To endorse the green cleaning in Sri Lankan healthcare sector, strategies from educational, government, management, market and product improvement domains were discovered. The most influential strategies were conducting awareness programs, enforcing government policies and regulations, availability of quality products, improved attitude of the custodians and increased marketing. Identified green cleaning strategies will provide strong background to systematically apply green cleaning in Sri Lankan healthcare sector.

Through this research knowledge on the green cleaning concept, practices come under green cleaning and its benefits to the humans and environment as well as an understanding of the barriers of green cleaning in Sri Lankan healthcare sector and the strategies to overcome those challenges were generated. Further developing a socio-economic scale of green cleaning to form a basis for comparison and measuring the contribution of green cleaning of achieving sustainable goals of an organization can be identified as further research areas related to this area.

Acknowledgement

I would like to convey my heartfelt gratitude to my inspirational dissertation supervisors, my assistant supervisor and the resource persons who support to make the attempt success.

References

Atamamen, F., Mohammed, A., Abdullah, M., Asmoni, M., & Hamid, H. (2016). A Conceptual Framework of Critical Success Factors for Green Cleaning Implementation and Performance. *International Journal of Real Estate Studies, 10*(2), 56-72. Retrieved from http://www.utm.my /intrest/files/2017/10/06_A-Conceptual-Framework-Of-Critical-Success-Factors-For-Green-Cleaning-Implementation-And-Performance.pdf

Boyce, J. M. (2016). Modern technologies for improving cleaning and disinfection of environmental surfaces in hospitals. *Antimicrobial Resistance and Infection Control, 5*(10), 1-10. doi:10.1186/s13756-016-0111-x

Chevan, L., & Copeland, D. (2013). Front-line engagement: Greening healthcare, improving worker and patient health and building better jobs. *New Solutions, 23*(2), 327-345. doi:10.2190/NS.23.2.h

Corbett, J., Wagner , D., & Esbensen , P. (2017). *Sustainability Guide: Global Green Cleaning*. (IFMA) Retrieved from IFMA Knowledge Library: http://community.ifma.org/knowledge_ library/m/free_fm_content/1057407

Dancer, S. (2011). Hospital cleaning in the 21st century. *European Journal of Clinical Microbiology & Infectious Diseases, 30*(12), 1473-1481. doi:10.1007/s10096-011-1250-x?null

Dancer, S. J. (2016). Dos and don'ts for hospital cleaning. *Current opinion in infectious diseases, 29*(4), 415-423. doi:10.1097/QCO.0000000000000289

Darly, M., & Pitt, M. (2012). Environmental cleaning in UK healthcare since the NHS Plan: A policy and evidence based context. *Facilities, 30*(1/2), 6-22. doi:10.1108/02632771211194248

Dumas, O., Wiley, A., Quinot, C., Varraso, R., Zock, J. P., Henneberger, P. K., . . . Camargo, C. A. (2017). Occupational exposure to disinfectants and asthma control in US nurses. *European Respiratory Journal, 50*(4), 1700237. doi:10.1183/13993003.00237-2017]

Environmental Protection Agency [EPA]. (2010). *Greening your purchase of cleaning products : A Guide For Federal Purchasers*. Retrieved from United States Environmental Protection Agency: https://www.epa.gov/greenerproducts/greening-your-purchase-cleaning-products-guide-federal-purchasers

Espinoza, T., Geiger, C., & Everson, I. (2011). The Real Costs of Institutional "Green" Cleaning. *Journal of Hospital Infection*, 1-15. Retrieved from https://pdfs.semanticscholar.org /6456/755d0b10461379fb266cb72918f25bf3d27b.pdf

Hennink, M., Hutter, I., & Bailey, A. (2010). *Qualitative Research Methods.* SAGE publications.

Hsieh, H.-F., & Shannon, S. (2005). Three Approaches to Qualitative Content Analysis. *Qualitative Health Research, 15*(9), 1277-1288. doi:10.1177/1049732305276687

Klungseth, N. J., & Olsson, N. O. (2013). Norwegian cleaning research: an overview and categorization. *Facilities, 31*(7/8), 290-313. doi:10.1108/02632771311317457

Markkanen, P., Quinn, M., Galligan, C., & Bello, A. (2009). *Cleaning in Healthcare Facilities Reducing human health effects.* Retrieved from https://noharm-uscanada.org /sites/ default/files/documents-files/63/Cleaning_in_Healthcare_Facilities.pdf

OSHA/NIOSH Infosheet. (2012). *Protecting Workers Who Use Cleaning Chemicals.* Occupational Safety and Health Administration. Retrieved from https://www.osha.gov/Publications /OSHA3512.pdf.

Quan, X., Joseph, A., & Jelen, M. (2011). *Green Cleaning in Healthcare: Current Practices and Questions for Future Research.* The Center for Health Design. Retrieved 02 15, 2018, from www.healthdesign.org/system/files/hhigreencleaning_paper.pdf

Quinn, M., Henneberger, P., Braun, B., Delclos, G., Fagan, K., PharmD, V., . . . Zock, J.-P. (2015). Cleaning and disinfecting environmental surfaces in health care: Toward an integrated framework for infection and occupational illness prevention. *American Journal of Infection Control, 43*(5), 424-434. doi:10.1016/j.ajic.2015.01.029

Sabharwal, J. (2015). Health Issues and Environmental Impact of Cleaning Agents. *International Journal of Novel Research in Life Sciences, 2*(2), 32-38. Retrieved from http://www .noveltyjournals.com/

Saito, R., Virji, M., Henneberger, P., Humann, M., LeBouf, R., Stanton, M., . . . Stefaniak, A. (2015). Characterization of cleaning and disinfecting tasks and product use among hospital occupations. *American Journal of Industrial Medicine, 58*(1), 101-111. doi:10.1002/ajim.22393

Senier, L., Mayer, B., Brown, P., & Frosch, R. (2007). School Custodians and Green Cleaners: New Approaches to Labor—Environment Coalitions. *Organization & Environment, 20*(3), 304-324. doi:10.1177/1086026607305740

Simcox, N., Wakai, S., Welsh, L., Westinghouse, C., & Morse, T. (2013). Transitioning from Traditional to Green Cleaners: An Analysis of Custodian and Manager Focus Groups. *New Solutions, 22*(4), 449-471. doi:10.2190/NS.22.4.e

Spruce, L. (2017). Back to Basics: Environmental Cleaning Hazards. *AORN Journal, 106*(5), 424-432. doi:10.1016/j.aorn.2017.08.013

Trajtman, A., Manickam, K., & Alfa, M. (2015). Microfiber cloths reduce the transfer of Clostridium difficile spores to environmental surfaces compared with cotton cloths. *American Journal of Infection Control, 43*(7), 686–689. doi:10.1016/j.ajic.2015.03.002

Xu, N. (2012). *Lean, Mean, Green Cleaning Machine: One School District's Quest for Sustainability.* https://pdfs.semanticscholar.org/76ff/8630db816786858dce16bf022fc131bf955e.pdf?_ga=2.12 8826188.1956870498.1568009021-369267505.1568009021