



Green Cleaning in Healthcare: Current Practices and Questions for Future Research

SEPTEMBER 2011

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Health Care Without Harm has initiated a research collaborative coordinated by faculty of the University of Illinois at Chicago School of Public Health, with support from the Pioneer Portfolio of the Robert Wood Johnson Foundation, aimed at stimulating collaborative research around health and safety improvements in health care. The Research Collaborative is designed to increase the evidence base concerning the impacts of sustainable design, construction, organization, operations, and materials and chemicals choices in the health care sector on patient, worker and environmental safety.

This paper is the ninth in a series of papers in which the Collaborative provides research and analysis of factors influencing patient, worker and environmental safety and sustainability in the healthcare sector. The editors of this series are Peter Orris, MD, MPH and Susan Kaplan, JD.

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Acknowledgements

We would like to thank case study interviewees Brian G. Kovaly, John Litchfield, Damian Natal, John J. Welenc, and Todd Wilkening, as well as all individuals who responded to the questionnaire survey. We also thank Janet Brown and Nancy DellaMattera for their help with online survey distribution. Special thanks go to advisory committee members Judene Bartley, Pat Burdullis, Janet Brown, Ridley Kinsey, Jason Marshall, and Hubert Murray for their guidance and support throughout the project. We would also like to thank Susan Kaplan for her guidance and input on various drafts of this report. We are grateful for the support from Health Care Without Harm and the Healthier Hospitals Initiative.

EXECUTIVE SUMMARY

Environmental cleaning plays a key role in preventing healthcare associated infections (HAIs). But many current cleaning practices in healthcare may negatively impact human health and the environment. Green cleaning is a new, promising approach to environmental cleaning that aims at reducing harm to human health and the environment while maintaining or improving the hygiene of the healthcare environment. While a growing number of healthcare facilities are adopting green cleaning practices, there are many essential questions around green cleaning that remain unanswered due to the lack of research in this area.

The objective of the Healthier Hospitals Initiative (HHI) Pebble Project is to promote and support development of green cleaning initiatives by better understanding current green cleaning practices and identifying future research topics of high priority. Under the guidance of an advisory group consisting of industry experts, the project team at the Center for Health Design (CHD) a) established a conceptual framework for green cleaning through literature review, b) conducted case study interviews with representatives from five major healthcare facilities, and c) conducted an online questionnaire survey of high-priority research questions around green cleaning.

The conceptual framework takes a systemic approach toward green cleaning. Factors around green cleaning generally fall into three groups: The healthcare hygiene system, external and internal factors impacting the healthcare hygiene system (e.g. regulations, sustainability movement, staff education and training), and outcomes influenced by healthcare cleaning and hygiene. The healthcare hygiene system is an integration of not only healthcare cleaning (including risk assessment and the selection, application, and disposal of cleaning agents) but building design (e.g. ventilation system, interior finish materials) and operational design (e.g. building maintenance, waste management). These components of the healthcare hygiene system interact with each other and other factors to influence multiple outcomes, including environmental cleanliness, risk of HAIs, health effects (e.g. asthma, dermatitis), environmental impact (e.g. bioaccumulation, waste, and

energy consumption), patient and staff satisfaction, and cost-effectiveness.

Eight green cleaning practices were found in the five case study facilities. These practices generally fall into three main categories: 1) selection of cleaning products (including green cleaners, cleaning tools or equipment that use less water and chemicals, and minimal number of chemical types); 2) operational change (including cleaning for appropriate levels of cleanliness, application and dispensing methods, and use of fluorescent marker); and 3) building design (including interior design that reduces the need for cleaning or facilitates cleaning, and layout that makes housekeeping more efficient). Variations exist in green cleaning practices across different facilities. The selection of cleaning products that contain or use less harsh chemicals is the most commonly adopted method. Operational changes commonly implemented include the establishment of appropriate cleanliness levels in different areas based on infection risk estimation and optimal application and dispensing of cleaning chemicals (e.g. squeezing or pouring chemicals directly onto cleaning cloth instead of spraying). All case study facilities have made efforts to select flooring materials that require less cleaning and maintenance, but research evidence is lacking to support informed decisionmaking on this issue.

The implementation of green cleaning usually involves strong leadership from facility administration and internal multi-disciplinary sustainability teams, as well as staff acceptance and ownership. Almost all case study facilities conducted initial evaluation of new products and procedures before implementation, but rarely monitored or evaluated the performance of the products and procedures after adoption. Certain healthcare outcome data have been routinely collected for other business purposes (e.g. infection prevention), but typically were not utilized in the evaluation of green cleaning. Anecdotal evidence from the case studies suggests that green cleaning generally results in benefits such as reduced use of water and chemicals, fewer complaints from staff and patients, and lower levels of infection rates.

The 150 respondents to the survey were mostly health-care staff, including environmental service managers, nurses, sustainability consultants and administrators. The majority of the respondents perceived green cleaning to be only a practice of selecting and using appropriate cleaning products, while other important aspects including operational changes and building design were largely ignored. The three most important research topics identified in the survey are 1) the effect of green cleaning on facility cleanliness and HAI prevention; 2) the effectiveness of green cleaning in protecting the environment; and 3) the health effects of green cleaning. Other important research topics identified include the cost-effectiveness of green cleaning and the development of standard methods to evaluate different green cleaning products and practices.

In conclusion, green cleaning is an interdisciplinary, systematic approach involving the selection and use of cleaning products as well as operational changes and building design. A variety of green cleaning products and practices have been implemented in healthcare facilities. However, one big challenge in implementing green cleaning is the limited evidence regarding the effectiveness of these products and practices.

The actual effects of green cleaning are typically not routinely monitored and evaluated, even though certain relevant data may already be collected for other purposes in various health care departments. For the ongoing development of green cleaning initiatives, it is urgent to conduct research focusing on practical questions from real settings, for example:

- How do green cleaning products/practices effectively impact environmental cleanliness and HAI transmission?
- How do green cleaning products/practices effectively impact the environment?
- How do green cleaning products/practices effectively impact human health (e.g. asthma, dermatitis)?
- What are the standard tools and methods for the comparative evaluation of various green cleaning products/practices?
- How cost-effective and feasible are certain products/practices?
- What are the advantages and disadvantages of various flooring materials in regard to cleaning?

I. INTRODUCTION

Green Cleaning in Healthcare

Maintaining the cleanliness of the healthcare environment and minimizing the concentration level of pathogens is an essential way of preventing healthcare-associated infections (HAIs), which pose serious threats to patient safety and contribute to an increase in healthcare costs (Schulster, et al., 2004). In addition, environmental cleanliness is a critical factor impacting other healthcare outcomes, such as patient satisfaction (Sofaer, Crofton, Goldstein, Hoy, & Crabb, 2005).

Various chemicals have been used in the cleaning procedure (removing visible soils such as soil particles and organic matter) and the disinfecting procedure (killing microorganisms) routinely performed in healthcare settings. A growing body of evidence suggests that the ingredients of many cleaning and disinfecting products may have unintended negative impacts on human health and the environment. Patients' and staff's exposures to cleaning chemicals can cause dermatitis, endocrine and neurologic effects, cancer, asthma, and other respiratory disorders (Delclos et al., 2007; Rosenman et al., 2003; Stingeni, Lapomarda, & Lisi, 1995). Cleaning chemicals may contribute to the pollution of outdoor air and water supplies, damage to ecosystems, bioaccumulation in animals and plants, and ozone depletion (Environmental Protection Agency, n.d.). Further, certain cleaning practices are found to be associated with musculoskeletal disorders in cleaning staff (Kumar, Chaikumarn, & Lundberg, 2005; Unge, Ohlsson, Nordander, Hansson, Skerfving, & Balogh, 2007).

Concerned about the adverse human and environmental effects of traditional cleaning practices, many healthcare organizations have been increasingly adopting green cleaning or sustainable cleaning practices. However, a commonly accepted definition is lacking, and 'green cleaning' has taken on different forms in different organizations. Green cleaning, or sustainable cleaning, generally refers to a variety of environmental cleaning approaches (e.g. selection of cleaners, use of alternative cleaning methods, changes in building design and operations) that aim at reducing the harmful effects of cleaning on human health and the environment while maintaining or improving the cleanliness of the healthcare environment for the purpose of infection prevention. Promising green cleaning efforts such as purchasing and using cleaners with more benign chemicals have been reported in multiple hospitals around the country.

However, many knowledge gaps exist around green cleaners and green cleaning programs (Markkanen, Quinn, Galligan, & Bello, 2009). For example, there appears to be a lack of industry agreement as to what constitutes a green cleaning program for a healthcare facility. Also, what kinds of cleaners should be defined as 'green?' Further, there is no clear evidence indicating whether cleaners that are promoted as 'green cleaners' effectively meet infection prevention needs and standards given the current focus on the environmental contribution to HAIs (Goodman et al, 2008) or whether such cleaners have unknown health risks; and there are no widely available data about the implementation and the effectiveness of the green cleaning programs in different healthcare facilities (Markkanen, et al., 2009; Sattar, 2010). There is an urgent need to conduct research around cleaning in healthcare to fill these knowledge gaps.

The HHI Pebble Project

This paper is the ninth paper in the Health Care Research Collaborative's monograph series providing research and analysis of factors influencing patient, worker and environmental safety and sustainability in the health care sector. The Research Collaborative was initiated by Health Care Without Harm (HCWH), an international nonprofit coalition that promotes environmental responsibility in health care, and is coordinated by faculty of the University of Illinois at Chicago School of Public Health, with support from the Pioneer Portfolio of the Robert Wood Johnson Foundation. The Research Collaborative's mission is to stimulate the development, coordination and dissemination of research focused on the impact of the health care built environment, operations and organization on patient, worker and environmental safety and sustainability. The Collaborative also interacts closely with the Healthier Hospitals Initiative (HHI), a group of health systems that are leading the way in implementing green practices in healthcare.

HCWH and HHI engaged with the Center for Health Design's (CHD) Pebble Project to promote and support research on green cleaning. The aims of this project were: To conduct a literature review in order to establish a conceptual framework for green cleaning, to conduct five best practice case studies in order to gather information about the current status and effectiveness of green cleaning practices, and to conduct a questionnaire survey of practitioners and experts in the field to identify high priority research questions around green cleaning in healthcare. In a future phase, HHI and HCWH will support and engage qualified researchers to investigate top priority research questions identified during this project. This report describes the methodology, procedures, and findings from this study.

II. METHODS

Under the guidance of an expert advisory group, the project team at CHD conducted the study in three steps. Literature review, phone interview and questionnaire survey were the major methods used in the study.

Expert Advisory Group

An expert advisory group provided guidance throughout the project. The group members had expertise in green cleaning but were from diverse backgrounds, including healthcare sustainability, infection prevention and control, healthcare operations, evaluation of cleaning chemicals and equipment, and building materials manufacturing. Regular conference calls between advisory group members and the research team were conducted. The advisory group provided feedback on the conceptual framework, identified healthcare organizations and field experts to be included in the case studies and the survey questionnaire, helped to refine the phone interview protocol and the survey questionnaire, and reviewed the final report.

Conceptual Framework/ Literature Review

The project team reviewed the 2009 Health Care Research Collaborative (HCRC) paper focusing on green cleaning in healthcare and some of the articles and reports about green programs that were specifically mentioned in the HCRC paper (Markkanen, et al., 2009). Based on the literature review and comments from the advisory group, a conceptual framework for green cleaning was established and refined. Then the conceptual framework was used to develop a case study interview protocol and a survey questionnaire.

Case Study

Based on the conceptual framework and HCRC paper, a phone interview protocol was developed for the best practice case studies. The protocol was divided into six sections (see Appendix I):

- General information about the healthcare organization (e.g. name, address, # of beds, type)
- Green cleaning program (e.g. risk assessment, cleaning products, building design, and operational changes)
- Implementation process (e.g. organization of the green cleaning program, logistics, timeline, challenges and difficulties)
- Evaluation methods
- Benefits and lessons learned
- High priority research questions
- In addition, the protocol asked for additional information and materials such as cleaning protocol and personal comments.

The recruitment of case study facilities was conducted through emails and phone calls. The advisory committee members recommended a total of seven healthcare organizations, as well as one or two individuals familiar with the green cleaning program at each organization. The project team contacted individual facilities by email and followed up with phone calls. However, not all identified facilities were responsive to the request for participation and one facility decided to withdraw after initially agreeing to participate. Therefore, several additional facilities were added to the list of potential participants. The recruitment process continued until five healthcare organizations agreed and completed the telephone interview.

A telephone interview was conducted with a representative from each participating facility. Four interviewees are the directors or managers of environmental/housekeeping departments. One is the director of the facility. The length of interviews averaged about 1 hour and ranged from about 45 minutes to 1.5 hours. The project team generally followed the interview protocol and made adjustments based on specific situations of

different organizations. Detailed notes were taken during each interview. Before each interview, the project team gathered information (e.g. web pages, presentations) about the green cleaning programs at the facility. After each interview, the project team followed up with the interviewee to request materials used in the green cleaning program and detailed results.

Questionnaire Survey

An online questionnaire was developed, based on findings from the 2009 HCRC paper and the case studies. The primary purpose of the questionnaire was to identify high priority research topics around green cleaning in healthcare. Respondents were also asked to define components of a green cleaning program, based on their experience/expert knowledge. The online questionnaire contained a total of 10 questions. In addition to selecting high priority topics from a list, respondents were also asked to provide examples of specific high priority research questions. The paper version of the questionnaire was reviewed and was revised based on feedback from the advisory group members. The online version was pre-tested with a small group of green cleaning experts.

The online survey was sent out by email to the listserv mailing list of Practice Greenhealth and the Healthcare Career Advancement Program (H-CAP), as well as a list of experts identified by the advisory members. A total of about 2,500 email notifications were sent out in the first round. Reminders were sent out one week and two weeks later to ask recipients to complete the survey.

Data Analysis

The data collected from case study interviews were sorted and compiled in a matrix, where the data was classified into several categories—green cleaning features, implementation, green cleaning definition, evaluation and results, and high priority research questions. Common themes were extracted from interview data through content analysis. Additional data provided by the interviewees were analyzed according to data type.

Questionnaire survey responses were collected using tools integrated in Survey Monkey and transferred to Excel format. The data were analyzed using descriptive statistics. Top research topics and questions were tabulated. Common themes were extracted from responses to the open-ended questions regarding the key components of green cleaning and most important research questions.

III RESULTS

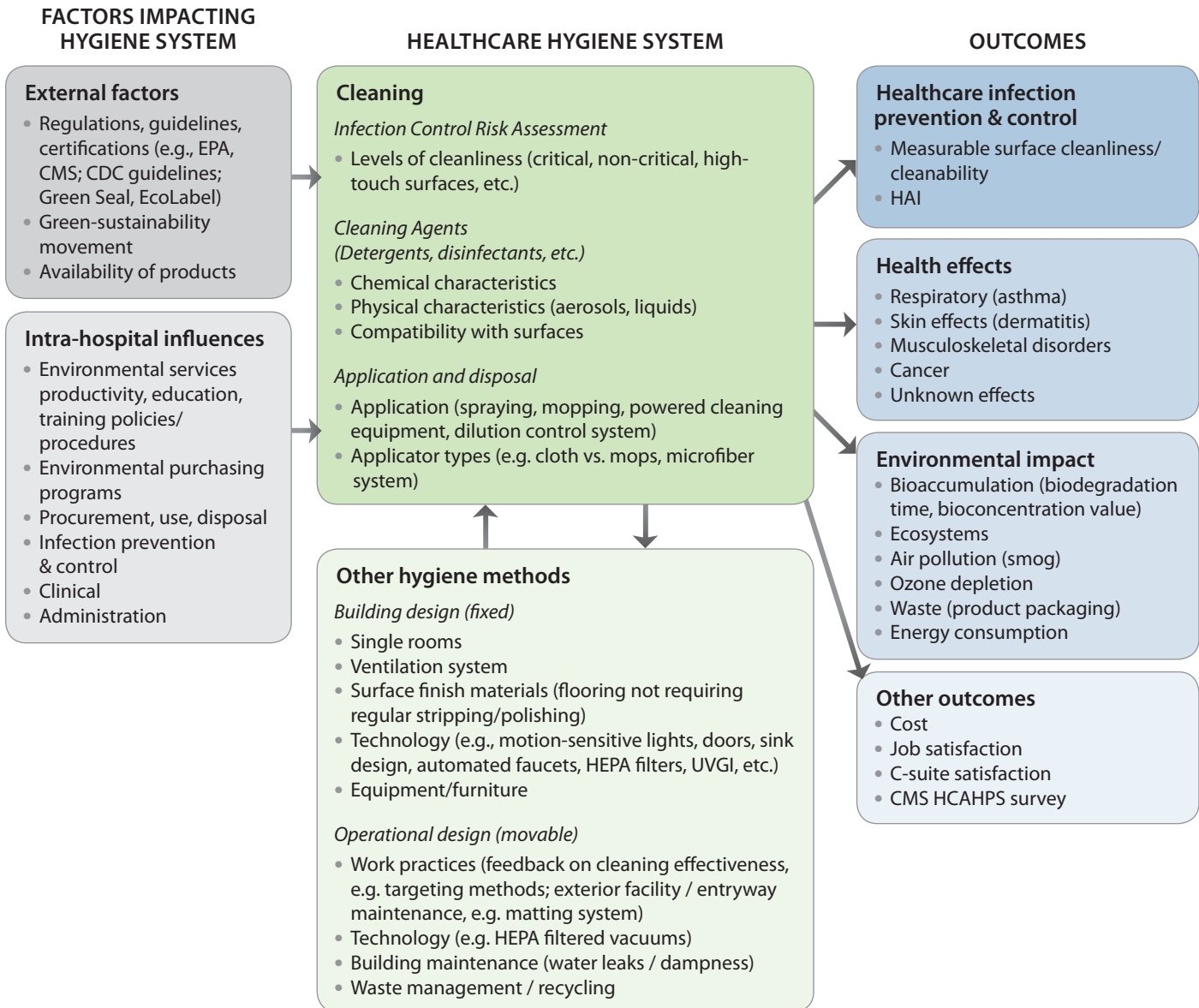
The Conceptual Framework

According to the literature, green cleaning generally refers to “cleaning to protect health without harming the environment,” or the efficacy of infection prevention and control “toward effective products with the fewest adverse effects on human health and the environment,” or “maintaining and improving cleanliness and supporting infection control while protecting workers and the environment from the risks posed by cleaning materials and processes” (ABM Industries, n.d.; Markkanen et al., 2009; Practice Greenhealth, n.d.). Even though there is not a definition of green cleaning that is widely accepted, the 2009 HCRC paper clearly indicated that green cleaning is a systematic approach including not only the use of cleaners identified as ‘green’ due to their chemical composition and attributes, but a comprehensive performance improvement process that includes any other methods that may reduce the negative impact of hospital cleaning on human health and the environment (e.g. using micro-fiber mops, improving performance of cleaning staff, and selecting finish materials that are easier to clean).

Based on the 2009 HCRC paper, a framework of green cleaning was created. The framework (see Figure 1) demonstrates factors around green cleaning in three columns:

- External and internal factors impacting healthcare cleaning: Many factors could impact the implementation of healthcare cleaning and the purchasing of cleaning products. For example, the sustainability movement acts as a driving force towards more attention to human health, including sensitivity to chemicals and pollutants in healthcare (Green Guide for Health Care, 2007). The limited availability and high cost of effective green cleaning products as well as skepticism from healthcare staff and administrators could impede the implementation and development of green cleaning (Markkanen, et al., 2009).
- Healthcare hygiene system: Healthcare cleaning is a key component of the healthcare hygiene system, which serves the purpose of controlling infections in hospitals by reducing cross-contamination of environmental surfaces (Guh, Carling, & Environmental Evaluation Workgroup, 2010; Carling et al., 2008). Other components of the healthcare hygiene system include building design (e.g. patient rooms, HVAC, finish material) and operational design (e.g. building maintenance, waste management). All the above components interact with each other and are integrated into an overall healthcare hygiene system (Markkanen, et al., 2009). For example, research found that building design may facilitate or hinder healthcare cleaning (Guenther & Vittori, 2008). Research also found that the amount of harmful exposure to cleaning chemicals was not only determined by the physical characteristics of cleaners (e.g. aerosols vs. liquids), but also impacted by types of cleaning tasks (e.g. spraying vs. mopping) and the built environment (e.g. ventilation) (Bello, 2008). Evaluation of thoroughness of cleaning was considered an essential element of a complete system (Guh et al., 2010; Carling & Bartley, 2010).
- Healthcare outcomes: The healthcare outcomes influenced by the healthcare hygiene system are classified into four categories—infection prevention and control, health effects, environmental impact and other outcomes. It is well documented that environmental hygiene is a key factor impacting the prevalence of environmentally-mediated HAIs among patients and healthcare workers (Sehulster et al., 2004; Ulrich et al., 2008; Goodman et al., 2008). As discussed previously, the practice of using strong chemicals to maintain environmental hygiene in healthcare may have some unintended effects, such as asthma in patients and healthcare staff, dermatitis and musculoskeletal disorders of cleaning staff, and bioaccumulation of chemicals in the environment (Delclos et al., 2007; EPA, n.d.; Unge et al., 2007). In addition, the cleanliness of the healthcare environment greatly impacts patient satisfaction with the overall healthcare services that they received (Krueckeberg & Hubbert, 1995). Cleanliness of the environment is used to measure patient satisfaction in the Centers for Medicare & Medicaid Services (CMS) Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) survey, as well as the Press Ganey patient satisfaction survey.

Figure 1. Conceptual Framework of Green Cleaning in Healthcare



Green cleaning aims at: 1) reducing hospital cleaning’s harmful effects on human health and the environment; 2) enhancing hospital hygiene and reducing infections. In order to develop green cleaning programs, an understanding of basic cleaning programs helps to focus on removal of soil/bioburden in a manner that permits evaluation of cleaning thoroughness. Then the least harmful cleaner can be used in developing a “green” cleaning program.

Case Studies

This section takes a close look at each of the individual green cleaning programs at the five participating healthcare facilities. Then it summarizes the common features of green cleaning programs across different facilities in order to explore current best practices and identify lessons learned that are applicable to other facilities.

Dartmouth-Hitchcock Medical Center, Lebanon, NH

Dartmouth-Hitchcock Medical Center (DHMC), New Hampshire's only academic medical center, includes a 396-bed acute care hospital, a medical school, a clinic, and a physician network. DHMC's green cleaning efforts began about 10 years ago, when green cleaners were introduced into the facility.

Green Cleaning Components

The main green cleaning features at DHMC include green benign cleaners, green floor finishes and strippers, finish materials requiring less cleaning and finishing, reduction of horizontal surfaces, movable furniture, floor mat system at entrances, vacuum cleaners, micro-fiber mops and cloths, new methods of dispensing and applying cleaning chemicals, and green pest control.

- Green cleaners: DHMC uses green cleaners certified by Green Seal, including the carpet cleaner, the glass cleaner, the degreaser and citric acid cleaner, as well as the all-purpose peroxy cleaner that is used on all other surfaces that do not need disinfection. A disinfectant not categorized as green is used to disinfect surfaces that patients frequently touch. Sensitivity and allergy concerns drove the shift from old style floor finishes with heavy metals and ammonia to green finishes and stripping methods.
- Interior design that reduces the need for cleaning and finishing or facilitates cleaning: This includes flooring finish materials that do not need regular finishing such as rubber flooring, large ceramic tiles with minimal grout, wall protection, reduction of horizontal surfaces that collect dust, and movable furniture at nursing stations and other places that helps to reduce interference between cleaning and other healthcare activities. In addition, DHMC utilizes a floor mat system at entrances and vacuum cleaners to reduce the need for chemical cleaning. The amount of soil and dirt inside buildings was reduced by using a floor mat system at each entrance and vacuuming and sweeping entrances.
- Cleaning tools or equipment that use less water and chemicals: DHMC adopted micro-fiber mops and cloths for cleaning, since they use less water and chemicals and generate less waste than the traditional string mops and cloths. To prevent cross-contamination, each mop head is used in only one patient room at DHMC. From the perspective of staff health, micro-fiber mops are lighter and easier to maneuver, thus may reduce staff fatigue and back injuries. DHMC is also using a new type of floor-scrubbing machine with specialized floor pads that use less floor stripper to remove finish from large floor areas more efficiently (less labor and time) (Clarke Autoscrubber with BOOST). Another type of floor machine used at DHMC helps to reduce chemical and water use by using a different application process in which self-collapsing foam attracts dirt more effectively (Nobles FAST technology). For cleaning surfaces, DHMC has adopted the use of a spray bottle that uses electrically charged water (ActiveIon). This technology claims to be effective in cleaning surfaces without the use of any chemicals.
- Application and dispensing methods: Metered chemical dispensers at DHMC reduce spills and waste of chemicals by carefully dispensing chemicals at the right dilution rate. A new practice of applying chemicals is to squeeze chemicals from a bottle with a pour spout onto a cleaning cloth. Compared to the old practice of spraying chemicals onto surfaces, this helps to avoid chemical aerosols entering indoor air. A new floor finish applicator is also used to contain floor finish in a box during application, thus prevent odors and volatile organic compounds (VOCs) from escaping into the air.

Implementation

The green cleaning program at DHMC has been evolving over recent years. The facility's leadership is a strong advocate of sustainability, willing to try new products or methods that enhance sustainability, even at an extra cost. Over the years, DHMC gradually increased the use of green cleaners and other green cleaning methods as they became available. Training and educating staff has been a key component of the green cleaning program. The environmental service department at DHMC includes supervisors and a training and quality assurance manager to oversee cleaning performance and provide training to new and existing staff. There were challenges and difficulties in the implementation of certain green cleaning measures. For example, cleaning staff sometimes were not willing to give up conventional practices (e.g. spray bottles, cotton string mops). This problem was successfully addressed by explaining to staff the benefits of new products and practices to personal health. However, some staff members still complain that micro-fiber mops do not clean as well as conventional mops.

Evaluation & Results

DHMC evaluates new cleaning products or procedures through visual inspection, customer survey, and

ATP (adenosine triphosphate) testing. ATP testing is a new method to efficiently evaluate the effectiveness of products and procedures and the performance of cleaning staff. However, the high cost of ATP testing prohibits its wide usage. Currently, DHMC uses ATP testing only in operating rooms, other procedure rooms, and patient rooms. In addition, staff injury data are collected and monitored by the safety department. However, this data was not accessible to the research team for this project.

It is estimated that green cleaning can be economically beneficial, especially when chemical usage is reduced or eliminated. Although detailed data are not available, it is evident that some green cleaning methods (e.g. micro-fiber mops) may result in significant reduction in use of chemicals and water. In addition, since the cost of green cleaners has dropped significantly in recent years, changing from conventional to green cleaners does not cause a significant cost increase.

Questions for Further Research

DHMC is interested in identifying the pros and cons of different flooring materials (including linoleum and rubber) in terms of ease of cleaning, installation, and so on.

Ridgeview Medical Center, Waconia, MN

Ridgeview Medical Center (RMC) is an independent, regional healthcare network including a Waconia-based 109-bed acute care hospital (about 242,000 SF), various primary and specialty care clinics, emergency services, and specialty programs. It serves the west-metro area of Minneapolis. At Ridgeview, green cleaning is an integrated management process aiming at using products with minimal toxicity to achieve hospital hygiene without increasing rates of HAIs. The facility began to implement green cleaning in 2003.

Green Cleaning Components

Major components of green cleaning at Ridgeview include the practice of using minimal toxicity cleaners to achieve appropriate levels of cleanliness in various areas, green benign cleaners, minimal number of chemical types in one facility, interior design resulting in less need for cleaning, a floor mat system,

location of housekeeping closets, and high-concentration chemicals.

- Cleaning for appropriate levels of cleanliness: Ridgeview follows CDC guidelines to determine appropriate cleanliness levels in different areas. To avoid potential negative impacts of using overly strong cleaning chemicals, only chemicals with minimal toxicity levels are used at least frequency as determined to be necessary for specific areas. Areas that only need general sanitation are not disinfected. For example, important clinical areas with high infectious risks such as ORs and ICUs may need more potent chemicals than general office areas. The facility used to clean floors in critical areas using phenolics and quaternary cleaners but later realized that it is not necessary to disinfect the flooring in critical areas since the flooring was always non-sterile anyway. Therefore, only least

toxic cleaners are used to clean OR floors. The facility also switched from quaternary cleaners to general sanitation in office and back room areas and reduced the frequency of chemical cleaning and the amount of chemicals used in critical areas such as ORs. According to Todd Wilkening, Director of Facilities, “Never dust with dynamite!” is a simplistic way of describing the industry’s norm of “over cleaning.” Wilkening adds that “through these process changes, no increase in infection rates is evident.”

- Green cleaners. Green Seal certified cleaners are used at Ridgeview, including the general purpose cleaner, the glass cleaner, cleaning and degreasing compounds, floor cleaners, waxes, and the restroom cleaner. Complaints from staff and patients regarding sensitivity to certain chemicals have led to the adoption of least toxic chemicals. In some areas, vinegar and water or soap and water are used to reduce the use of toxic chemicals and reduce the amount of personal protection devices such as eye shield and gloves that are used. Further, it is noted at Ridgeview that it is important to select cleaning products that have minimal aerosolization and fragrances, in order to improve indoor air quality. This includes the use of fragrance free chemicals. The amount of waste, including used containers of cleaning chemicals, is also reduced by using high-concentration chemicals.
- Minimal number of chemical types: Increased risks of long-term cumulative effects may be associated with the existence of many different types of chemicals in one healthcare setting. Ridgeview has been making efforts to identify versatile cleaners that can clean multiple types of surfaces. However, it has been challenging to find a one-size-fits-all product.
- Interior design that reduces the need for cleaning and finishing or that facilitates cleaning: A well-designed HVAC system, finish materials that are easy to clean and maintain, and a good matting system are interior design features adopted at Ridgeview Medical Center that reduce the chemical cleaning required. When selecting products, thinking of the “end in mind” operationally is critical. Service departments need to be involved during the design process in order to reduce operating expenses and toxicity in the workplace. According to Todd Wilkening, “If you study the model of *integrated medicine*, it is a no brainer!” He adds, “It becomes about living your faith through your organization’s mission.”

- Layout that makes housekeeping more efficient. Ridgeview has conducted modeling studies to examine how the location of housekeeping closets impacts the footsteps and travel distance of cleaning staff members. Lean construction modeling was used to minimize staff walking. Fewer footsteps could be translated into more cleaning time, better cleaning performance, less need for re-cleaning, and lower cost to the organization, not to mention less staff fatigue, which leads to greater staff satisfaction and performance.. However, this data is not currently being collected by the organization.

Implementation

Ridgeview’s green cleaning program is driven by its quadruple bottom line—social, economic, and environmental benefits, and passion for the organization and the community. Both facility leadership and staff ownership are important to the success of the program. A value analysis team, including representatives from nursing, material management, finance, environmental and facility services, and infection control, plays an important role in the program. The team members review products from different (sometimes conflicting) perspectives, reach compromises, and provide recommendations to department managers. The sometimes conflicting interests lead to making the best well-rounded decisions for an organization. This is truly a health “*dynamic tension*.”

As a part of the integrated patient care initiative, the green cleaning program emphasizes the training of staff and the education of patients. New staff members usually go through a formal orientation process to learn about the appropriate use of various kinds of chemicals. During staff education, evidence about the toxicity of conventional cleaners and the benefits of green cleaners has been an effective tool to facilitate the transition to green cleaners. Through education, staff members understand the personal and professional benefits of green cleaning.

The identification and selection of suitable green products is one challenge encountered in implementing green cleaning. First, it takes time (from several days to months) to evaluate, select, and procure new products. Second, sometimes it is difficult to find the right product. When the program began in 2003, few green cleaners were cost-effective. This forced Ridgeview to look at different manufacturers or go back to conventional cleaners that were more toxic, which was not

desirable. However, when looked at holistically, green cleaners are not costly, according to Ridgeview, when the costs of personal protective equipment (PPE) and employee risk are added into the equation. Although more green cleaners have become available recently, it is still difficult to find a one-size-fits-all cleaner in order to minimize the number of chemical types. Another challenge is the false perception of many people that any sustainability efforts would cost a lot and sacrifice business for the environment. Education, external pressures, and guidelines are critical to overcome these challenges.

Evaluation & Results

Ridgeview conducts pilot tests on new products and periodically re-evaluates cleaning products regarding their effects on staff health after they are accepted into the facility. The re-evaluation and replacement of cleaners may be justified when there is a change in

staffing (e.g. new staff with hypersensitivity issues). For the evaluation of new products, manufacturers are asked to provide material safety data sheets (MSDSs) and the carbon implications of using the products (including the environmental impact of the manufacturing process, although this could be a very rough estimate). The facility typically monitors costs of supplies, cleaning staff hours per square footage, HAI rates, employee illness, and job satisfaction, although some of the data are collected for purposes unrelated to the cleaning program. In addition, the facility conducts culture tests to assess surface cleanliness, though this is not a consistent effort and data is difficult to interpret. According to Paul Whittaker, Environmental Services Manager at Ridgeview Medical Center, “Based on the overall cost data, the cost of green cleaning is at or slightly above the historic level, and green cleaning is not a financial burden for the facility.”

Magee-Womens Hospital of UPMC, Pittsburgh, PA

Magee-Womens Hospital of UPMC is a specialty women and children’s hospital providing a wide range of services. It has 350 patient beds, an emergency room, and ambulatory facilities on four floors. It was a stand-alone hospital before it merged with UPMC in 1999. Magee-Womens started its sustainability initiative, including green cleaning, in 2006. At Magee-Womens, green cleaning is the balancing of sustainability with effectiveness against HAIs. It goes beyond the selection of cleaning chemicals and includes other factors such as equipment, interior finish materials, and the amount of packaging for cleaning products.

Green Cleaning Components

The green cleaning program at Magee-Womens includes several key components: Various levels of cleaning for areas with different risk levels, use of green cleaners, selection of flooring materials that need no stripping and waxing, using cleaning machines that require minimal chemicals, and use of micro-fiber mops,

- Cleaning for appropriate levels of cleanliness: The facility utilizes different methods to clean different areas of the facility depending on the level of disinfection and cleanliness required from an infection

prevention and control perspective. For example, bleach wipes are used in daily cleaning on high touch surfaces in patient rooms such as TV remote control, over-bed tables, door knobs, and bedside equipment, which tend to get contaminated through contact with staff and patients, but are not used in public areas. A spray bottle quaternary cleaner is used to clean high touch surfaces in those rooms where patients complain about the smell of bleach wipes.

- Green cleaners: The facility currently uses two Green Seal certified products—a neutral floor cleaner and a glass cleaner. However, there is no green disinfectant available to clean up blood and body fluids. As a result, the facility uses a chemical disinfectant for that purpose.
- Interior design that reduces the need for cleaning and finishing or that facilitates cleaning: The facility is switching from conventional VCT flooring that requires regular stripping and waxing to a type of wood-looking linoleum sheet vinyl (luxury vinyl tile) which does not need stripping and waxing.
- Cleaning equipment using minimal chemicals: A type of floor-cleaning machine (Tennant Eco-H2O) uses electrically charged water to attract and remove

dirt so that chemicals are not used. Micro-fiber mops are extensively used in patient areas at Magee-Womens. The implementation of micro-fiber mops was initiated from infection prevention concerns. When using conventional mops, it is required to change mop heads every 3-4 rooms, but this rule was not always followed by cleaning staff, posing a significant risk of cross-contamination. When using micro-fiber mops, one mop head is used in only one patient room so that the possibility of transmission of pathogens through contaminated mops is greatly reduced. Further, the square shape of micro-fiber mops makes it easier to clean dirt from edges and corners, although it may take a little more time to mop a room or an area.

Implementation

Magee-Womens' green cleaning program aims at providing a safe environment for everybody in the hospital, including patients, visitors and workers. The program is led by a hospital-wide green team, with strong support from hospital leadership. The team consists of about 30 people from different departments—environmental services, dietary, facility, nursing units, education, pharmacy, administrator, and office staff. The team's monthly meetings usually focus on sustainability issues reported from different departments.

One of the challenges encountered during the implementation of green cleaning at Magee-Womens was convincing staff to change from conventional string mops to the micro-fiber mops. For staff members, this was a significant change in daily practice. Major educational efforts, including meeting with vendors and infection prevention and control personnel, helped to change the old habits and obtain acceptance from staff. Another challenge during the introduction of micro-fiber mops was justifying the extra costs in order to gain support from the system-wide purchasing department. The hospital does not have an in-house laundry service to clean soiled mops. It turned out to be quite expensive to have an outside company clean the micro-fiber mops in its own facility and then deliver the clean mops back to the hospital. A preliminary cost analysis balancing the costs of micro-fiber mops with the savings from reducing potential infections helped the decisionmaking process. This was also facilitated by the support from the administration.

Evaluation & Results

Magee-Womens' evaluation of a new cleaning product typically begins with requesting efficacy data and MSDS from the vendor. The staff members from environmental services and infection control departments then evaluate the product's advantages and disadvantages. Sometimes, trials are conducted so that front-line staff members can try out the products and provide feedback. For example, before introducing the Eco-H2O machine, trials were conducted for several weeks and the cost analysis provided by the vendor was evaluated. The purchase was justified by the fact that the savings from using less quantity of chemicals may offset the incremental cost of purchasing the machine in the long run.

For Magee-Womens, some of the potential benefits from the adoption of green cleaning practices include the reduction of healthcare associated infections and reduced complaints from staff and patients. The Environmental Services manager at Magee-Womens believes that the practice of changing micro-fiber mop heads between patient rooms significantly reduces the risks of infection. However, they have not conducted any research studies to evaluate this hypothesis. The staff and patients used to complain about the offensive smell of flooring stripping and waxing. These complaints have become minimal or non-existent after switching to no-wax flooring. The measurements of the effects of green cleaning could use certain data routinely collected by the hospital for other purposes, such as budgets for chemicals and infection rates. However, the data have not been used to critically evaluate green cleaning efforts.

Questions for Further Research

Magee-Womens is interested in researching how effective green cleaners are in killing germs and how practical green cleaners are in the real world (for example, some cleaners need to sit on surfaces for more than 15 minutes to effectively remove soils or kill germs, which is not considered to be practical in daily usage).

Boulder Community Hospital, Boulder, CO

Boulder Community Hospital (BCH) is a 172-bed general acute care hospital serving Boulder County in Colorado. Environmental services at BCH is managed by ARAMARK, an international company providing environmental services as well as food services, facility services, and transportation services. ARAMARK is responsible for cleaning a total of 593,000 square feet of space. At BCH, the term “sustainable cleaning” is preferred over “green cleaning.” It refers to cleaning in the most effective way to reduce the usage of environmental resources and reduce negative impacts on the environment, community, patients, and staff.

Green Cleaning Components

The main components of sustainable cleaning at BCH include: Proper cleaning levels in different areas, green cleaners, micro-fiber mops and cloths, new methods of dispensing and applying cleaning solutions, and interior finish materials that are easy to clean or require low maintenance.

- Cleaning for appropriate levels of cleanliness: Different cleaning products and procedures are used according to the risk levels of cross-transmission of infections in various areas. For example, a light duty green cleaner is used on floors, except for operating rooms, where a disinfectant is used. The environmental services staff regularly cleans windows, blinds and carpets in the office area. However, office occupants clean their work spaces so that the amount of work by the cleaning staff can be reduced.
- Green cleaners: BCH uses cleaners designed by Ecolab for ARAMARK, which has strict requirements regarding cleaners. All cleaners except for disinfectants are green products. A chemical solution distribution system is used to reuse bottles to reduce waste.
- Cleaning tools or equipment that use less water and chemicals. BCH was among the first hospitals to use Eco-H2O machines that use ionized water to clean floors. Micro-fiber mops and cloths are used to save on water and chemicals.
- Application and dispensing methods. Instead of spraying, cleaning solution is contained in a bucket and directly applied to mops and cloths through

capillary action. This method ensures that a correct amount of cleaning solution is distributed. The saturated mop/cloth is used to clean floors and other surfaces. The cleaning cloth can be folded so that there are eight cleaning surfaces. In this way, fewer cloths are needed to clean the same amount of space.

- Interior design that reduces the need for cleaning and finishing or facilitates cleaning. BCH's interior design committee looks at the sustainability of interior design and selects materials that are easier to clean (such as vinyl furniture) and flooring that needs less frequent or no finishing, stripping, and waxing.

Implementation

Sustainable cleaning at BCH is a system-wide effort (including outside vendors) led by a sustainability committee consisting of 12 members from facility management, nutrition, hospital administration, nursing, purchasing, clinical and clerical departments. It is implemented with ARAMARK's SpaceCare QL program, which was developed as a best practice system of cleaning tools, techniques, and procedures for the improvement of efficiency of environmental cleaning in healthcare. As a simple example of the SpaceCare QL approach, stocking most frequently used tools, such as gloves, at a standard spot on top of the housekeeping carts has been found to improve efficiency.

Regular training and education has been an important factor in implementing sustainable cleaning. Sustainability coaches at ARAMARK provide coaching to facilities. The head of the BCH environmental services department goes through formal training provided by ARAMARK every three years and then trains his managers, supervisors, and staff. Supervisors conduct daily rounding to observe cleaning performance and provide feedback and coaching to cleaning staff. The inspection-training tour is essential for maintaining the quality of environmental cleaning. During the coaching process, the supervisor typically demonstrates the correct cleaning procedure once, asks the staff member to perform in the same manner twice, and then asks the staff member to teach the procedure back to the supervisor.

One challenge was that the staff found it difficult to switch from conventional mops to micro-fiber mops. The staff tended to stick with the old habits and revert back to using the conventional mops. Multiple methods were used to promote the use of micro-fiber mops—removal of old conventional mops from the workspace, education of staff members about the benefits of new mops (e.g. safer, sustainable), and the inspection-training process as described above.

Evaluation & Results

BCH environmental services routinely monitors consumption of chemicals and other products, and waste generation. It also utilizes an inspection program, including a score checklist developed by ARAMARK for the routine inspection of patient room cleaning. HAI rates and hand hygiene data are available from the infection control department. This data was unavailable for the purpose of this study.

According to the director of environmental services at BCH, there was no incremental cost for green cleaning for BCH—the initial cost of implementing sustainable cleaning (e.g. extra cost for micro-fiber mops) will be paid off or even exceeded by the benefits in the long run (e.g. reduced chemical and water use, fewer staff back injuries). It is estimated that micro-fiber mops use only one gallon of water for every 25 patient rooms, compared to 100-200 gallons used by conventional mops for the same number of rooms. Additionally, the new method of applying chemicals to cleaning cloths (see above) is estimated to reduce cleaning chemicals by one third.

Questions for Further Research

For BCH, an important research topic is the impact of sustainable cleaning on patient safety—in particular, how different green cleaning practices may help to reduce HAIs.

Cleveland Clinic, Cleveland, OH

Cleveland Clinic is a world-renowned multi-specialty academic medical center that integrates inpatient/outpatient care, research, and education (with 3.6 million outpatient visits and about 48,000 inpatient admissions in 2008). For Cleveland Clinic, green cleaning is defined as the best cleaning practice for the environment, considering the environmental impact of the use and production of cleaners.

Green Cleaning Components

Main components of green cleaning at Cleveland Clinic include: Use of green cleaners, selection of easy-to-clean finish materials, adoption of cleaning tools or equipment that use less water and chemicals, and use of fluorescent markers for the purpose of improving cleaning performance.

- Green cleaners: All cleaners are certified green products provided by a local company. Standard cleaners are used throughout the facility, including window cleaner, general purpose cleaner, and bathroom cleaner.
- Interior design that reduces the need for cleaning and finishing or facilitates cleaning: Cleveland Clinic has opted to use hard surfaces such as vinyl-free resilient flooring and durable hard surfaces, as they are considered easier to maintain and clean compared to other materials such as carpet.
- Cleaning tools or equipment that use less water and chemicals: Micro-fiber mops are used to reduce the consumption of water and chemicals as well as to reduce risk of infection. The cleaning chemical is put in a bucket and is applied to the mop rag using a dipping procedure. One rag is used in only one room, so that the cleaning solution is good to use for the whole day. In the past, the cleaning solution needed to be changed every three rooms. A Tennant Eco-H2O machine similar to what has been described previously has been used to clean the lobbies and corridors in the facility for the past few months. The machine helps to save chemicals since it uses only ionized water.
- Fluorescent marker: The performance of cleaning staff is evaluated by putting fluorescent markers on high touch surfaces before the cleaning and using a black light to check whether the markers have been removed after the cleaning. The method is used at Cleveland Clinic to provide feedback to cleaning staff on the thoroughness of their cleaning and to aid in the training of staff.

Implementation

Cleveland Clinic's green cleaning effort was initiated by the organization's leadership about two years ago. The effort was led by the Office for a Healthy Environment (OHE), which is responsible for the overall sustainability initiative at Cleveland Clinic. Education is the most important factor in the implementation of green cleaning. During education, frontline staff members were informed about the benefits to their own health, the work process and the environment. New staff members typically go through a two-day orientation process, during which each new staff member is teamed up with an experienced staff member for two to three weeks to learn cleaning skills and procedures. During the orientation process, the fluorescent marker-black light method is used for training purposes.

Evaluation & Results

The environmental services staff works with OHE to verify whether a cleaning product meets green standards.

Environmental services, OHE, and infection prevention are three departments involved in the evaluation of new products. A new cleaning product is usually tested through trials conducted in various parts of the facility, in addition to examining data from the manufacturer (e.g. material safety data sheet). During the trials, the effectiveness of cleaning products is determined by the appearance of cleanliness as well as testing by a swab meter, which indicates the difference in cleanliness before and after cleaning. Cost analysis is also conducted on certain products. For example, an analysis of chemical use savings helped to justify the purchase of the Eco-H₂O machine. In addition, patient satisfaction with the cleanliness of patient rooms is collected from the HCAHPS survey for evaluation of environmental cleaning.

Questions for Further Research

For Cleveland Clinic, it is important to test new products on a small scale in real life environments before adoption for wide use.

Case Study Summary

Common Green Cleaning Practices in Participating Facilities

There are eight green cleaning practices found in the individual case studies. These practices apply to various aspects of environmental cleaning. They generally fall into three main categories: 1) selection of cleaning products (e.g. cleaners, equipment, tools); 2) operational changes (e.g. appropriate cleanliness levels, application, dispensing methods, fluorescent markers); and 3) building design (e.g. interior design such as flooring material selection, layout design). Table 1 summarizes the different green cleaning practices adopted by the five participating facilities. It is evident that some variations exist in green cleaning across different facilities. Some practices are more commonly used than others.

Selection of Cleaning Products

The most commonly adopted practice is the selection of cleaning products that contain more benign chemicals or reduce the use of chemicals. All of the five facilities reported that they use green cleaners, most of which are certified by Green Seal. However, in some facilities the

use of green cleaners is quite extensive, including all the cleaners except for disinfectants, while in other facilities only a relatively small portion of cleaners are identified as "green." Using micro-fiber mops and cloths is another widely adopted method to reduce the use of chemical and water and at the same time improve infection control, because the characteristics of the material makes it feasible to use one mop head/cloth per patient room, eliminating a significant source of cross-contamination. New promising technologies such as a type of machine/device using electrically charged water for surface cleaning serve as an promising alternative for chemical cleaning. In addition, minimizing the number of chemicals in one specific facility could help to reduce potential hypersensitivity issues and reduce the risks of long-term cumulative effects. However, the lack of a one-size-fits-all chemical prevents the wide adoption of this method.

Operational Changes

One operational change that has been most commonly implemented in the participating facilities is the establishment of appropriate cleanliness levels in different healthcare settings based on careful examination of risks of infections. This helps to reduce the risks

Table 1. Green Cleaning Practices in the Five Case Study Facilities

Green Cleaning Practices		DHMC	RMC	Magee-Womens	BCH	Cleveland Clinic
Selection of cleaning products	Green cleaners	✓	✓	✓	✓	✓
	Cleaning tools or equipment that use less water and chemicals	✓		✓	✓	✓
	Minimal number of chemical types		✓			
Operational change	Cleaning for appropriate levels of cleanliness		✓	✓	✓	
	Application and dispensing methods	✓			✓	
	Fluorescent marker					✓
Building design	Interior design that reduces the need for cleaning and finishing or facilitates cleaning	✓	✓	✓	✓	✓
	Layout that makes housekeeping more efficient		✓			

involved in the overuse of strong chemicals in areas (such as administrative offices) where infection transmission risks are low. Another important operational change is the optimization of application and dispensing methods. One common example is the shift from the practice of spraying chemicals to the method of squeezing or pouring chemicals directly onto the cleaning cloth. This is anticipated to reduce the aerosolization of chemicals and improve indoor air quality. Less adopted but promising operational changes include fluorescent markers that are innovative in evaluating and improving the thoroughness of cleaning by providing accurate objective feedback to cleaning staff.

Building Design

All participating facilities have focused on selecting flooring materials that are easy to clean and maintain. Hard flooring such as rubber flooring, linoleum, and ceramic tiles that do not need frequent stripping and waxing is generally preferred. However, the advantages and disadvantages of different flooring materials have not been systematically evaluated even though research has begun to examine various aspects of flooring materials (e.g., DuBose & Labrador, 2010; Lent, Silas, & Vallette, 2009). This converging attention on flooring materials suggests that this is a problematic area in practice that needs to be researched. Floor mat systems at building entrances are used to reduce the amount of soil and dirt entering the buildings in at least two facilities. Other building design methods of facilitating or reducing the needs of

environmental cleaning include the reduction of horizontal surfaces, the optimization of the heating ventilation, and air-conditioning (HVAC) system, movable furniture, and convenient locations of housekeeping closets.

Implementation of Green Cleaning

Strong leadership from facility administration is the key to success of a green cleaning program, which is typically a part of the overall sustainability initiative in a healthcare organization and is led by an internal multi-disciplinary team including stakeholders from departments such as infection control, environmental services, purchasing, and facilities management. This multi-disciplinary organization format fits well with the systematic approach to green cleaning as recommended by the 2009 HCRC paper. In addition, staff acceptance or ownership is identified by the interviewees as an indispensable factor for the smooth transition from traditional cleaning practices to greener practices. In some cases, staff members' complaints and concerns about the health effects of certain chemicals, such as sensitivity issues, serve as a driving force toward a greener and safer cleaning process. However, the case study facilities often encounter some staff members' resistance to change from the status quo, which some staff members feel more comfortable with. For instance, many interviewees reported that a challenge to the implementation of micro-fiber mops was convincing staff to use them, because micro-fiber mops were significantly different from conventional string mops in terms

of daily cleaning practices. Focus group meetings with vendors and infection control personnel, explanation of benefits of micro-fiber mops, and removal of conventional mops from the work environment are effective methods that encouraged staff acceptance. Another challenge was the limited availability of cost-effective green cleaners and limited evidence around the effectiveness of the cleaners that claimed to be “green” by manufacturers. This calls for more research and development efforts on this topic.

Evaluation & Results of Green Cleaning

One important finding from the case studies is that almost all facilities conduct some evaluation of a new product or procedure (e.g. gathering information from vendors or manufacturers, conducting trials of new chemicals in a small area) before its formal implementation. However, they rarely perform regular monitoring and evaluation of how the product or procedure works in the real world and how it impacts the organization’s long-term outcomes (e.g. cleanliness, infections) after implementation. Most interviewees reported that certain relevant data were collected for other purposes in the organization (e.g. patient satisfaction score, budget for the environmental service department, patient infection data collected by the infection control department), but were not used for the evaluation of the green cleaning program. As a result, it required significant effort for the interviewees to gather the relevant outcome data from various sources so that meaningful evaluation using hard data can be made. This lack of readily available data clearly indicates a need for research in this area, but may also pose a challenge for research.

Another challenge lies in the fact that multiple factors may contribute to the relevant outcomes. For example, the reduction of HAIs could be due to the combination of improved medical device design, patient care practices, and better environmental cleaning. Therefore, the CDC and other experts do not recommend use of infection rates as a direct evaluation measure without controlling for other factors. However some sites did attempt this, though the data were not readily available. Some tools used at case study sites, such as adenosine triphosphate (ATP) testing, fluorescent markers, and culturing, enable direct evaluation of the cleaning process and measurement of amount of soil/pathogens in the environment that could ultimately

contribute to HAIs. Other evaluation methods include the use of existing medical and administrative records (e.g., staff injuries, patient satisfaction score), cost analysis, questionnaire survey, and so on.

Although objective and reliable evidence is lacking, subjective reports from interviewees suggest that green cleaning practices generally result in savings in water and chemicals, fewer complaints about odors and health effects from staff and patients, and a reduction in HAIs..

Survey of High Priority Research Topics/Questions

Respondents

A total of 157 online questionnaires were collected. Seven respondents completed the questionnaire twice. The duplicate responses were identified by the same names, job titles, and companies/organizations, then were removed from analysis. Therefore, there were 150 respondents to the survey. Environmental service managers in healthcare constituted more than one quarter of the respondents (see Figure 2). Other major groups of respondents included healthcare staff (nurse, physician, and other staff), sustainability consultants/experts, and administrators. About 7% of respondents fall into the category of “other”, which includes manufacturers, students, and other professionals. The vast majority of respondents work in inpatient hospitals, clinics, and other clinical settings. Only 14% respondents work in non-healthcare settings (see Figure 3).

Key Components of Green Cleaning

Selection of cleaning products, operational changes, building design, and reasonable cost are the key components of green cleaning as identified by survey respondents (see Table 2). The vast majority of respondents mentioned the selection of sustainable or environmentally friendly products that are effective in cleaning and preventing cross-transmission of infections. There are four major criteria in selecting products: 1) minimal toxicity/harm to human and environment, 2) recycling and reduction of waste, 3) minimal use of natural resources, and 4) effectiveness of HAI prevention. It appears that many respondents tend to perceive green cleaning as a practice of selecting and using appropriate cleaning products (especially the minimization of

Figure 2. Occupations of survey respondents

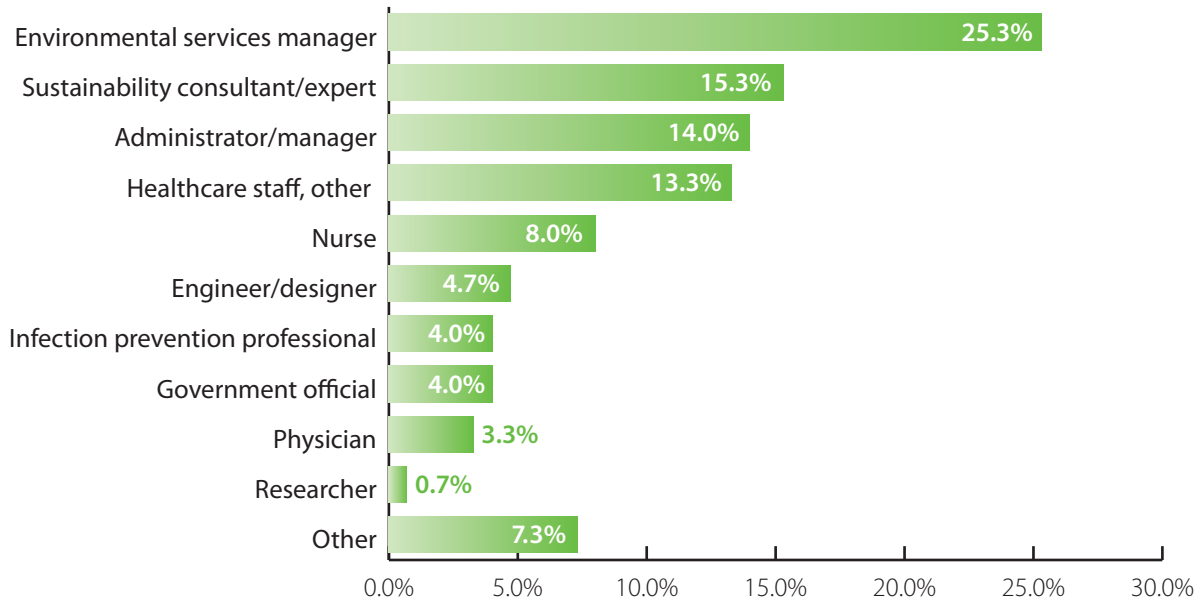


Figure 3. Work settings of survey respondents

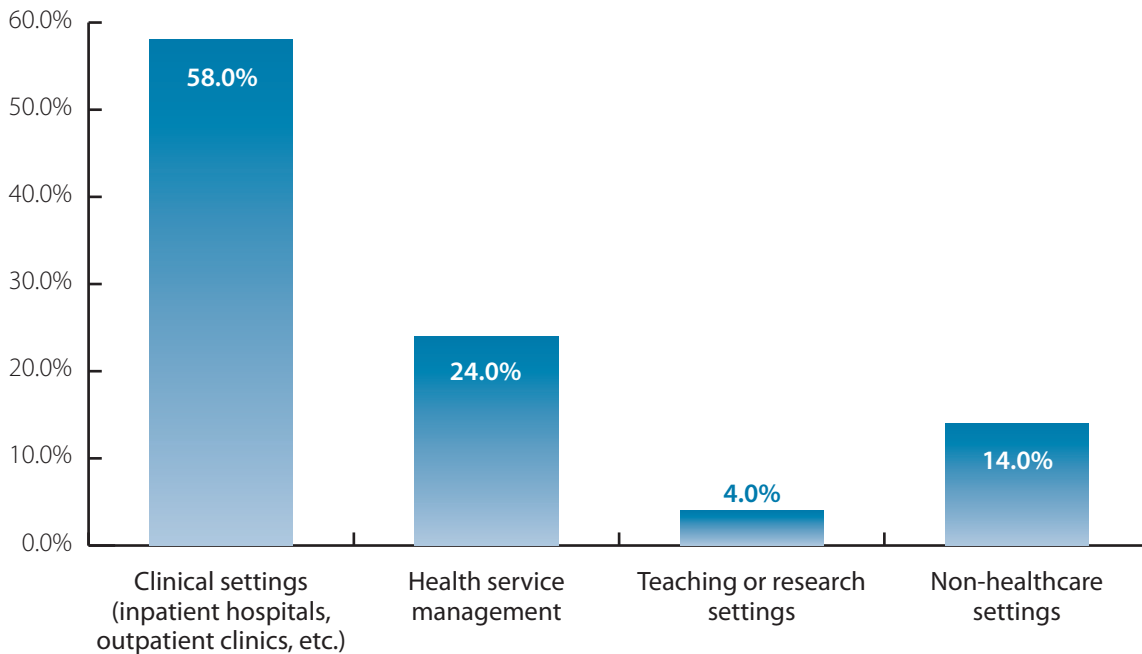


Table 2. Key components of green cleaning as identified by survey respondents

Selection of products				Operation	Building design	Cost
Toxicity/harm	Waste/recycling	Resource use	HAI prevention			
93%	35%	17%	28%	16%	2%	1%
<ul style="list-style-type: none"> Minimal chemicals Non toxic, non polluting Low VOC Safe for patients, workers and environment Credible 3rd party certification Free of chlorine, aerosolized agents, fragrance Minimal number of chemicals used on a daily basis 	<ul style="list-style-type: none"> Recycled, recyclable, and biodegradable content Minimized packaging and waste Proper disposal Chemical dispensing systems to reduce waste in dispensing 	<ul style="list-style-type: none"> Minimal use of water, energy, and other natural resources Reduction of carbon footprint 	<ul style="list-style-type: none"> Cleaning efficacy Compliance with regulations Reduction of cross contamination 	<ul style="list-style-type: none"> Risk assessment Appropriate training of workers Staffing levels Cleaning process: Vacuuming, mats at entrances, etc. Proper storage of cleaning products Standard operating procedures (routine, daily, terminal) Appropriate application Use of only minimal amount of chemicals necessary 	<ul style="list-style-type: none"> Ventilation Interior finishes (e.g. alternatives to waxed floors) Ultraviolet machines 	<ul style="list-style-type: none"> Cost at same level or lower than traditional cleaning

Note: Percentage indicates the portion of respondents who include the components in their responses.

toxicity and potential harm to human and the environment), while omitting other important aspects of green cleaning such as operational optimization and building design (reported by only 1% to 16% respondents). It is necessary to facilitate the dissemination of new knowledge of green cleaning so that a systematic approach (as recommended by Markkanen et al., 2009) can be more widely accepted and applied in practice.

High Priority Research Topics

Evaluating green cleaning’s effects on healthcare facility cleanliness and controlling HAIs is recognized as a very important research topic by over 70% of the respondents. The other two of the top three topics also focus on the effectiveness of green cleaning—the effects on the environment and on the health of patients and staff (see Figure 4). Another research topic—the cost-effectiveness of green cleaning—is very important for decision making. Other important research topic areas (selected by at least 30% of respondents) include the development of standard methods for evaluating green cleaning products and practices, innovative green cleaning practices, and the standard definition of green cleaning. About 10% of respondents selected the “other” category and provided specific topics such as the balancing of environmental impacts and HAI prevention, a framework/strategy for tracking occupational exposure rates related to cleaning, alternative cleaning methods such as electrolytic solution and ozonation, and antibacterial materials.

When asked to select the single most important research topic, 27.5% of respondents chose the effects of green cleaning on facility cleanliness and HAI prevention. Other research topics chosen by more than 10% of respondents include: The effects of green cleaning on environmental impacts (15.7%), the development of standard methods for evaluating specific green cleaning products/practices (13.7%), and the effects of green cleaning on the health of staff and patients (11.8%) (see Figure 5).

The survey responses clearly indicate that it is a top priority to examine whether green cleaning products or practices live up to their promises--maintaining environmental cleanliness and reducing HAIs, as well as reducing potential harms to the environment and to the health of staff and patients. Further, the responses also suggest that it is important to develop a set of standard evaluation methods in order to compare the effects of different products and practices.

High Priority Research Questions

A complete list of high priority research questions recommended by survey respondents is included in Appendix IV. The questions can be classified into several topic areas: Consideration of multiple factors for decision making, HAI prevention, environmental impacts, health effects, implementation, cost/ROI, standards/evaluation methods, and definition of green cleaning. One significant finding is that many research questions focus on the balancing of multiple factors

Figure 4. High priority research topics in green cleaning

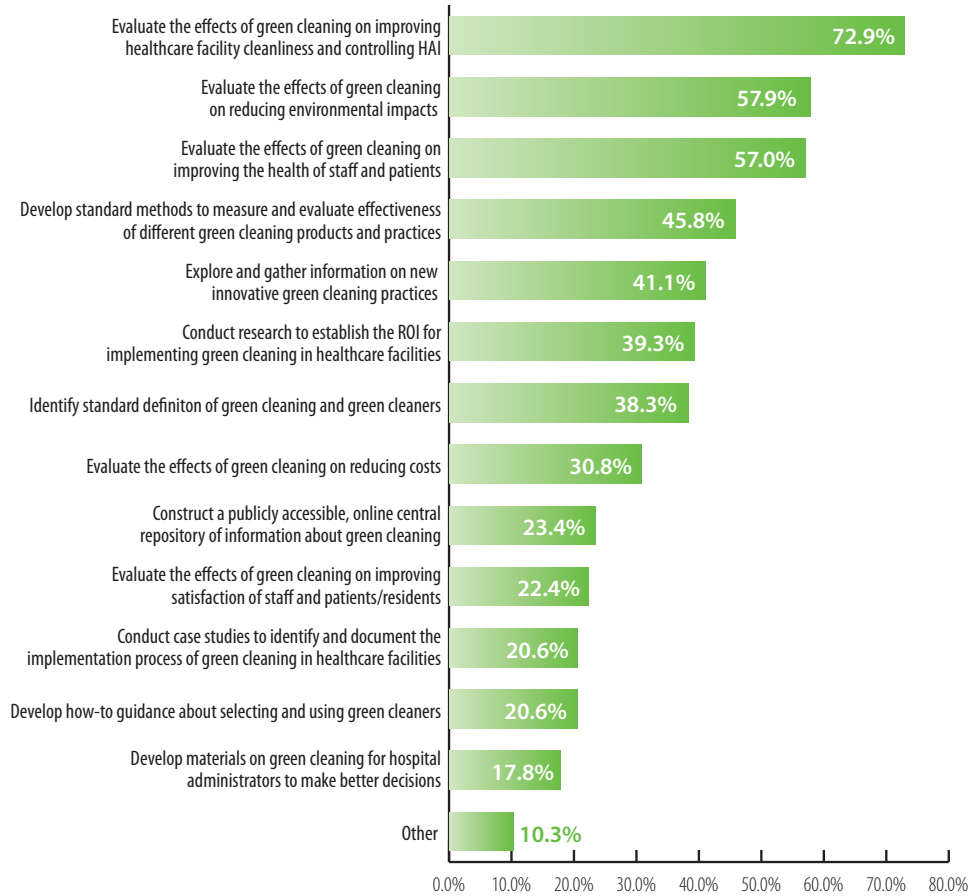
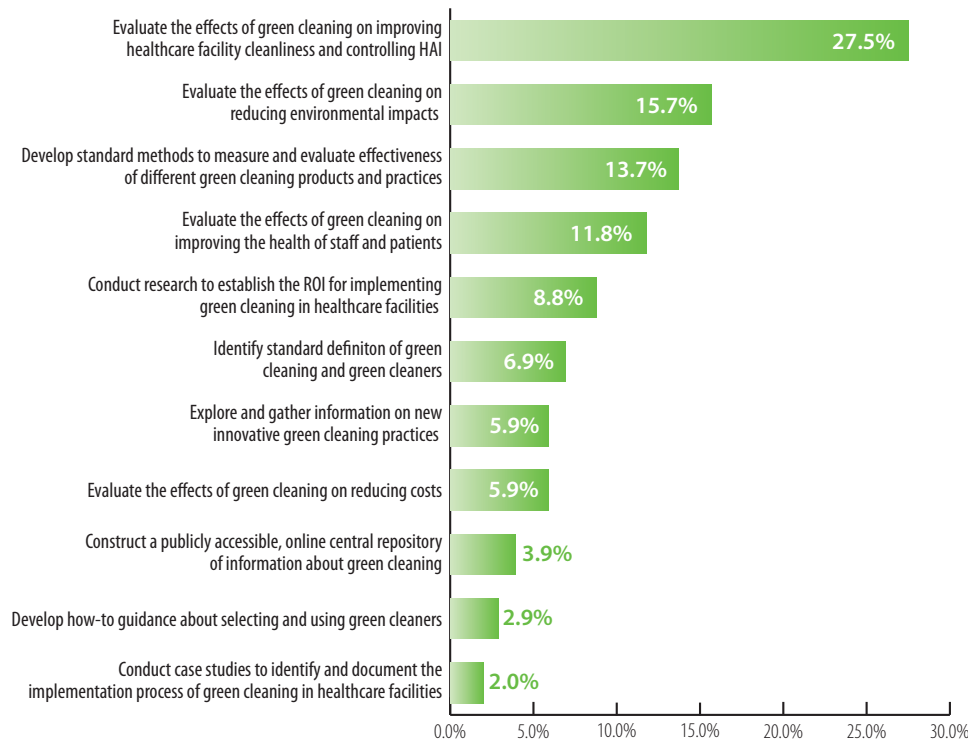


Figure 5. The most important research topic on green cleaning



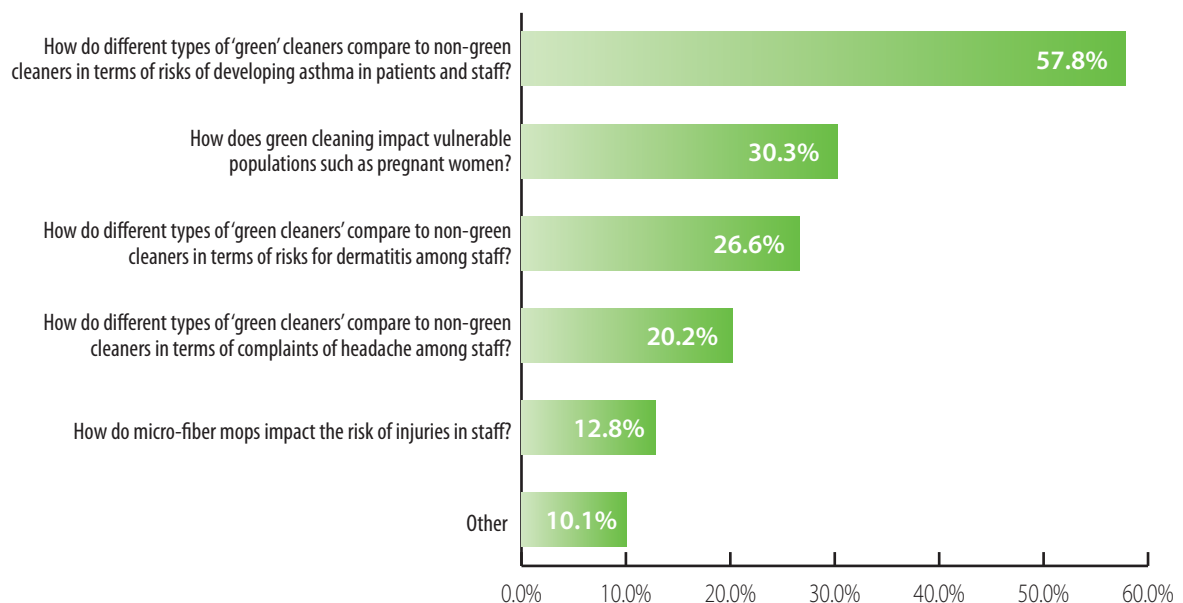
around green cleaning (e.g. HAI prevention, environmental impacts, health effects, and cost) to inform the decision making of whether to adopt green cleaning products and practices in the real world. The following is a list of sample research questions from respondents (see Appendix IV for the complete list):

- What are the most effective cleaners with the least toxicity for cleaning areas with high infectious potential?
- Are there any green cleaners that will effectively kill the *C. difficile* spores on inanimate surfaces?
- What is the total environmental impact of green cleaners and process (e.g. considering energy use, products, disposal and long-term impact)?
- Is there any chemical absorption of the cleaning chemicals for neonates due to their immaturity?
- How do we shift the thinking that EVS personnel are only housekeepers, and make the culture shift that they are Infection Prevention Specialists?
- How can the ROI analysis reflect sustainable return on investment for green cleaning? (i.e. improved patient outcomes, etc. that do not usually get included in cost analysis)
- What criteria are appropriate to determine the cleaning ability of a cleaner?

Research Questions About Green Cleaning’s Effects on Staff and Patient Health

Survey respondents were asked to select high priority research questions among a set of five questions in the topic area of green cleaning’s effects on the health of patients and staff (see Figure 6). The impact of green cleaning on asthma risks were identified as the most important research question, followed by the impact on vulnerable populations such as pregnant women and the impact on dermatitis risks. Some respondents suggested additional research questions that were not listed in the questionnaire. These additional research questions focus on the impact of green cleaning on complaints of eye and nasal irritation and cough, the effects of noisy equipment, noxious scent of cleaners, and overall health effects.

Figure 6. High priority research questions around green cleaning’s effects on staff and patient health



IV. CONCLUSION

Green cleaning is an interdisciplinary, systematic approach. It involves the selection and use of cleaning products as well as operational changes and building design. Its implementation requires inter-departmental cooperation and support from healthcare leadership. Green cleaning aims at balancing and addressing multiple needs— environmental cleanliness for infection prevention and control, environmental impact, human health effects, and so on. The development of green cleaning calls for innovations in various fields (e.g. chemistry, management, environmental design). These innovations (e.g. new products and practices) should be evaluated empirically by using sound and standard methods to examine their effects on multiple outcomes.

However, limited research has been done in real working environments, and post-implementation evaluation is rarely conducted once a specific green product or practice has been adopted, even though certain relevant data may be already collected for other purposes in various healthcare departments. The effectiveness of green cleaning products and practices needs to be established before wide implementation can take place. An urgent need is to conduct credible research to examine and monitor the impact of various green cleaning products and practices on outcomes (especially infection prevention, the environment, and the health of staff and patients) and to disseminate the research findings. Important research topics and questions include:

- How do green cleaning products/practices effectively impact environmental cleanliness and HAI transmission?
- How do green cleaning products/practices effectively impact the environment?
- How do green cleaning products/practices effectively impact human health (e.g. asthma, dermatitis)?
- What are the standard tools and methods for the comparative evaluation of various green cleaning products/practices?
- How cost-effective and feasible are certain products/practices?
- What are the advantages and disadvantages of various flooring materials in regard to cleaning?

DISCLAIMER

This report is based on case study interviews, a questionnaire survey, and a review of literature. Accuracy of information included in the section of case studies depends on the subjective reporting from interviewees. The survey results reflect the opinions of those individuals who voluntarily participated. Mention of certain products and practices in this report does not indicate the effectiveness of these products or practices and does not suggest endorsements of the authors and the sponsoring organizations.

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APPENDIX I. CASE STUDY PHONE INTERVIEW PROTOCOL

HHI Pebble Project case studies
Questionnaire
January 2010

Health Care Without Harm - Healthy Hospital Initiative (HHI) along with The Center for Health Design's (CHD's) is pulling together five best practice case studies on green cleaning in healthcare facilities. The project aims at synthesizing available research and best practice information on green cleaning in healthcare and identifying research priorities on green cleaning. Your facility has been invited and is voluntarily participating in the case study.

*We will be conducting an hour-long interview with you and your colleagues with the intent to learn more about your cleaning program. It would be helpful to have some demographic information about your facility prior to the call. We would appreciate it if you could fill out **section A** and send to the CHD researchers ahead of the call.*

*The remaining sections provide an outline of the questions we will be seeking answers to during the interview. You **do not need** to fill these out and send to us. This is for your reference only. You may need to work with your colleagues in the departments of environmental services, purchasing, infection control, and others to collect the relevant information.*

Thank you for your participation.

A. General Information of Healthcare Organization

Name of healthcare facility _____

If part of larger health system, please provide the name of health system _____

Address _____

City/State/Zip _____

Number of licensed beds _____

Number of staffed beds _____

Building square footage _____

Number of adjusted occupied beds _____

Note: Number of adjusted occupied beds = Average inpatient daily census + (10% of Total outpatient procedures and clinic visits / total calendar days)

Type of facility

- General acute-care hospital
- Community hospital
- Teaching hospital
- Children's hospital
- Psychiatric
- Rehabilitation
- Long-term care
- Outpatient clinic
- Other _____

CONTACT INFORMATION OF THE RESPONDENTS

Name _____

Title _____

Department _____

Phone _____

Email _____

Name _____

Title _____

Department _____

Phone _____

Email _____

B. Green Cleaning Program

1. Definition, goals and reasons:
 - Can you describe the different aspects of the cleaning program at your facility?
 - According to you what constitutes a green cleaning program?
 - What are the major goals of the cleaning program in your organization?
 - What are your reasons for implementing this program?

2. Baseline cleaning system at the facility:
 How did the cleaning system at the facility work BEFORE the current cleaning program was implemented? What were the key components of the cleaning system? What worked well and what did not? Did the facility use any risk assessment protocols? Why did the organization move away from the previous cleaning program to the current one?

3. Key components of the green cleaning program:
 - Risk Assessment for selection of needed cleanliness:
 - How does the facility determine appropriate levels of needed cleanliness in different areas (e.g. ICU, lobby, high touch surfaces, OR, bathroom)? Are there any standards that you use to determine cleanliness levels?
 - What are the appropriate levels of cleanliness in different areas/surfaces as determined in risk assessment? Has the facility identified areas where use of disinfectants can be minimized or eliminated? If yes, please list these areas.

- Please list the green cleaners used at the facility:

Cleaner type	Do you use green cleaners? If yes, please indicate green cleaner certification.	
General purpose (hard surface) cleaners	Yes/No	Green Seal; EcoLogo; EPA; Other: _____
Glass cleaners	Yes/No	Green Seal; EcoLogo; EPA; Other: _____
Carpet and upholstery cleaners	Yes/No	Green Seal; EcoLogo; EPA; Other: _____
Cleaning and degreasing compounds	Yes/No	Green Seal; EcoLogo; EPA; Other: _____
Floor cleaners, strippers, waxes	Yes/No	Green Seal; EcoLogo; EPA; Other: _____
Metal polish	Yes/No	Green Seal; EcoLogo; EPA; Other: _____
Drain/grease trap additives	Yes/No	Green Seal; EcoLogo; EPA; Other: _____
Fragrances/odor control additives	Yes/No	Green Seal; EcoLogo; EPA; Other: _____
Laundry soaps/cleaners	Yes/No	Green Seal; EcoLogo; EPA; Other: _____
Antimicrobial liquid hand soap	Yes/No	Green Seal; EcoLogo; EPA; Other: _____
Other: _____	Yes/No	Green Seal; EcoLogo; EPA; Other: _____

- For different cleaning strategies or cleaners that are at your disposal - how do you determine the risk of implementing these? That is, do you isolate any of these cleaners/strategies to make sure this works?

- Cleaning products:
 - What criteria does your organization use to select cleaning products? Are there specific aspects of the cleaning products that lead to improvements in cleaning effectiveness, human health effects, environmental impacts, and cost savings? Do you look at any data on these products prior to making your selection? What are the sources of data regarding different products that you typically use? How do manufacturers' recommendations impact the selection of cleaning products? Can you provide specific information of the cleaning products (for example MSDS)?
 - What are the improvements in the application and disposal of the cleaning products (e.g. powered cleaning equipment minimizing noise and capturing fine particulate matter, dilution control system) that have been implemented as a part of the green cleaning program at this facility? How could these improvements support your cleaning program?
- Building design:
 - What are the improvements/changes in building design that may support your cleaning program by reducing the use of cleaning chemicals, improve hospital hygiene, and reduce negative impacts on staff health and the environment? Examples: single rooms, flooring that does not require regular stripping and polishing, HEPA filters, choices of equipment/furniture, etc., power washers
- Operation:
 - What improvements or changes in operation have been made that may support your green cleaning program? Examples: appropriate levels of needed cleanliness in different areas/surfaces (for example, OR vs. ICU vs. lobby), micro-fiber mops, feedback on cleaning effectiveness using fluorescent markers, building maintenance.

C. Implementation Process

4. Organization:
 - How does green cleaning fit into your organization's mission and goals?
 - How do your organization's administrators support the green cleaning program? What do you think is the role of hospital leadership in implementing an effective cleaning program?
 - Is this incorporated as part of a patient-focused model of care? Is that communicated to patients as a component of healing environments?
 - How is the program team organized? Was it organized as a team? Who are the members of the team? Examples:
 - Stakeholders: management/administration, clinical staff, occupational and environmental officers, operations and facilities personnel, laboratory personnel, marketing, community relations, purchasing department
 - Core members: Environmental services; infection prevention, safety officers, sustainability specialist, members of product selection team
5. Logistics of green cleaning program:
 - What locations/areas in the facility is the green cleaning program implemented?
 - Are there any incremental costs of implementing green cleaning (cleaning products, building design, operational changes, number of staff, time)? How do you track these incremental costs? How is the program financed?
 - Did the staff receive education/training about the new cleaning program? Can you describe the education/training program?
 - Supervision/quality control of training

6. Timeline of the program:
 - When were the key steps of the program implemented? Please list the dates of key milestones. Example of steps: Practice Greenhealth 10-step guide of green cleaning (form a team and gain commitment → review current products and practices → evaluate and categorize facility areas → determine evaluation criteria for products and operations → select products → develop a pilot plan → execute pilot – training and feedback → pilot evaluation → celebrate success → expand the efforts)
7. Challenges and difficulties:
 - What were the challenges/difficulties in the implementation of the green cleaning program in your organization (e.g. gaps in knowledge, leadership engagement, difficulty in persuading staff, perceived risk in trying something new)?
 - What might be some of the methods and process of overcoming the challenges and difficulties? What would lower the barriers for implementing green cleaning programs? e.g. third party endorsement, leadership outside hospital system-like EPA

D. Evaluation methods

8. What are the methods (data collection and analysis) used to measure the effectiveness of cleaning programs in the following aspects? What data are available for the evaluation?
 - Cleaning thoroughness/effectiveness. Examples: swab cultures, agar slide cultures, fluorescent markers, ATP bioluminescence, microbial analysis, infection rates, other metrics. direct observation of staff (assessment for sustaining training)
 - Human health effects. Examples: self reported symptoms, work-related injuries, absences, and complaints.
 - Environmental impacts (e.g. bioaccumulation, air pollution, energy consumption)
 - Savings resulted from the green program.
 - Other methods (e.g. HCAHPS, job satisfaction, etc.)

9. To whom are results of achievement reported? ICC, quality committee, senior management board of trustees? How often are they reported? And what form does the report take? Anything you can share with us?

E. Results

10. Benefits: What are the actual benefits that your organization has seen to be a result from the green cleaning program in the following aspects?
 - Cleaning effectiveness
 - Human health effects
 - Environmental impacts
 - Savings
 - Other significant benefits
11. Lesson learned:

What are the lessons learned in the process of implementing green cleaning? How are these lessons going to be applied to future programs?

F. Research Questions

12. What are the key research questions around your cleaning program that your organization would like to study?
13. Concerning the overall field of green cleaning, what are other research questions that are important to answer?

G. Additional materials

14. Materials used in the green cleaning programs
 - Floor plan
 - Program documentation (e.g. specific green cleaning plan)
 - MSDS (Material Safety Data Sheets)
 - Poster
 - Other _____

15. If you would like to provide additional information about the green cleaning program at your facility or you have other comments, please provide here:

APPENDIX II. GREEN CLEANING RESEARCH PRIORITY SURVEY QUESTIONNAIRE

Green Cleaning Research Priority Survey

Introduction

Health Care Without Harm - Healthier Hospital Initiative (HHI) along with The Center for Health Design (CHD) is conducting a survey of high priority research topics around green cleaning in healthcare facilities. You are invited to participate in this survey because you have been actively involved in green cleaning and sustainable design issues in healthcare. Your answers will be aggregated to inform the development of research projects to make healthcare cleaning more sustainable.

This online questionnaire will take about 5-10 minutes to complete. Thank you for your participation.



Green Cleaning Research Priority Survey

A. Your Professional Background

* 1. What is your occupation

- Physician
- Nurse
- Infection prevention professional
- Environmental services manager
- Healthcare staff, other than the above
- Administrator/Manager
- Researcher
- Engineer/designer
- Sustainability consultant/expert
- Government official
- Other (please specify)

* 2. In which of the following settings do you work?

- Clinical settings (inpatient hospitals, outpatient clinics, etc.)
- Teaching or research setting
- Health service management
- Not healthcare settings (please specify)

3. Please tell us your name, job title, and company/organization.

Name:

Job title:

Company/Organization:

B. Definition of 'Green Cleaning'

* 4. Green cleaning may have different meanings for different people. Please tell us the definition of 'green cleaning' that you use.

Green Cleaning Research Priority Survey

C. High Priority Research Topics in Green Cleaning

*** 5. In your opinion, which of the following research topics are very or extremely important in the area of green cleaning in healthcare? Please select 3-5 research topics with highest priority.**

- Identify standard definition of "green cleaning" and "green cleaners"
- Evaluate the effects of green cleaning on improving healthcare facility cleanliness and controlling healthcare-associated infection (HAI)
- Evaluate the effects of green cleaning on improving the health of staff and patients
- Evaluate the effects of green cleaning on reducing environmental impacts (eco-footprint, pollution, bio-accumulation)
- Evaluate the effects of green cleaning on reducing costs
- Evaluate the effects of green cleaning on improving satisfaction of staff and patients/residents
- Explore and gather information on new innovative green cleaning practices (e.g. innovative technology, operation)
- Develop standard methods to measure and evaluate effectiveness of different green cleaning products and practices
- Conduct case studies to identify and document the implementation process of green cleaning in healthcare facilities
- Develop how-to guidance about selecting and using green cleaners
- Construct a publicly accessible, online central repository of information about green cleaning
- Develop materials on green cleaning for hospital administrators to make better decisions
- Conduct research to establish the return on investment (ROI) for implementing green cleaning in healthcare facilities

Other (please specify)

*** 6. If you selected more than one topic as very or extremely important in the above, please indicate which topic you think is the most important to conduct research on:**

*** 7. Please identify 1-3 specific research questions around green cleaning that are very or extremely important to study. For example, a specific research question could be: How does a green cleaner compare to a conventional cleaner in killing germs?**

Green Cleaning Research Priority Survey

D. Green Cleaning's Impacts on Health of Patients and Staff

*** 8. Please identify specific research questions that are important in the evaluation of green cleaning's effects on improving the health of staff and patients**

- How do different types of 'green' cleaners compare to non-green cleaners in terms of risks of developing asthma in patients and staff?
- How do different types of 'green cleaners' compare to non-green cleaners in terms of risks for dermatitis among staff?
- How do different types of 'green cleaners' compare to non-green cleaners in terms of complaints of headache among staff?
- How do micro-fiber mops impact the risk of injuries in staff?
- How does green cleaning impact vulnerable populations such as pregnant women?
- Other (please specify)

E. Comments

9. If you have additional comments about this questionnaire or green cleaning in general, please provide here:

Thank You

Thank you for completing this survey!

APPENDIX III. SELECTED MATERIALS FROM THE FACILITIES

Appendix III. (Part 1) Product Evaluation Process Worksheet – Ridgeview Medical Center

Product Evaluation Process Worksheet

This section to be filled out by Requester

1. Buyer receives Product Eval Process Wksht and completes analysis.
2. Buyer presents Product Eval Process Wksht to the appropriate Value Analysis Committee. (Buyer will notify Requester of the date.)
3. If trial is needed, Buyer and Requester will start the process.
4. If product request is approved, Buyer will complete the changes and the Requester and affected departments will be notified of the change.

Name of Person Initiating Request: _____ ext. _____
 Date: _____

Dept Director Notified:	By Requester	Yes	No
	By Buyer	Yes	No

Item Description/Name _____

Item Purpose _____

Manufacturer Name: _____ Mfg Number: _____

Reason for Change (Please check as many as apply—any additional information you can provide is very helpful!)

1. Patient/Staff Safety
 - Infection Control
 - Sharps Safety
 - Latex Issue
 - JCAHO Requirement
 - Safer Chemical Option
 - Additional Safety Issue: _____

2. Improves Patient Care ***Research Center can provide more data and clinical research*
 - New Technology
 - Easier to Use/More Efficient
 - Improved Quality of Product
 - Improved Pt Outcome
 - Improved Pt Comfort
 - Misc _____





3. Change in Practice

- Physician Request
- Service Line Request
- Change in Regulation
- JCAHO Requirement
- Misc _____

4. Financial Opportunity

- Contract Opportunity
- Change in Tier Level
- Standardization Program
- Pricing Opportunity
- Misc _____

5. Environmental Factor

- Generates Less Waste
- Easier/More Efficient Disposal
- Reduced Toxicity
- Misc _____

6. For Chemicals, MSDS requested and reviewed Yes No

This Section to be Filled out by Value Analysis Committee

Product Assigned to Buyer: _____ Date: _____
 Value Analysis Committee: _____

Product Information

Sales Rep: _____ Phone: _____
 Vendor: _____





Vendor Part #: _____

Packaging: _____

Vendor Notes: _____

Product Standardization

1. Can we eliminate a currently used item if we add this product? **Yes** **No**

2. Product to be eliminated: _____

 (cost info will be included in financial analysis)

3. Do we need to add a product that is similar to a currently used item? **Yes** **No**

Reason to have duplicate items: _____

4. Are there any other items that will be affected by this product change/addition?

Contract Information

1. Is the **current** product covered under a contract?

Novation # _____
 Standardization Program _____
 Independent Ridgeview Agreement _____
 Contact name: _____

2. Is there a penalty for changing the product? **Yes** **No**

3. Is the **proposed** product covered under a contract? **Yes** **No**

Novation # _____
 Tier level? _____
 LOC required? **Yes** **No**
 LOC signed on: _____
 Standardization Program _____
 Potential Validation Form signed on: _____
 Independent Ridgeview Agreement _____
 Volume commitment required? **Yes** **No**

Inventory Information

1. Will multiple areas be using this product? **Yes** **No**

2. Can the item go into Stores? **Yes** **No**





Cost Analysis: See Attached Spreadsheet

Final Cost Savings: _____

Final Cost Increase: _____

Do we need information from/for?

- Biomed**
- Infection Control**
- Service Line Leader**
- MSDS Coordinator**

Communication to All Affected Departments (To be determined)

Who to communicate with:

Department	Leader	Annual Usage	Contact Date

How to communicate with identified group:

- Email**
- Phone**
- In Person**
- Nurse Manager Meeting**
- Leadership/Director’s Council**
- Printed Information**
- Newsletter**

If the change will result in a net increase in supply cost it will need to be brought to Supply Core Process Team:

Sponsor of Core Process Team

Signature of Materials Director



>

Trial or Conversion?

Attach any trial results.

Trial Plan: _____

Communication of Decision to All Affected Departments

(Same as above)

Who to communicate with:

Department	Leader	Annual Usage	Sign Off
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

Conversion Approved?

Yes

No

Date Conversion Complete: _____

Item Number: _____

Total Cost Implication: _____

RMC Procedure/Guideline: CRITICAL CARE UNIT - DAILY CLEANING
P10006

Department: Environmental Services Review/Revision Date: 11-01-2010

Purpose (if applicable): Because of the nature of the patient's condition in this section, special care must be followed when cleaning. Do a thorough cleaning, exercising caution around the equipment that is being used.

Guidelines/Definitions:

The Department Supply Reference identifies s the location, purpose, proper handling, MSDS concerns and personal protective equipment (PPE) needed for various department supplies.

- Cleaning cart stocked with all necessary supplies. See [policy #2821](#).

Procedural Steps:

1. Wash and dry your hands. Put on gloves. Wear safety glasses and a gown when there is a possibility of a body fluid or chemical splash.
2. Empty waste baskets, wipe with damp cloth or wash out if necessary & replace liners.
3. Damp dust furniture and fixtures, use hand duster for high surfaces.
4. Clean bathroom according to procedure #2166.
5. Check for and remove dust webs.
6. Inspect drapes. If soiled call ext. 5700 to have maintenance remove them so they can be washed by linen staff.
7. Spot clean soiled areas on walls and doors
8. Replenish supplies, paper towels, tissue, and soap
9. Put up a Wet Floor sign. Damp/wet mop floors using disinfectant solution. Change microfiber mop after every three rooms, or about 2,000 square feet.
10. Visually check room before leaving. Report maintenance issues by calling extension #5700.





Attachment A: Required Housekeeping Cart Contents

At the end of each work shift, all housekeeping carts will be checked for the following supplies and equipment:

- | | |
|----------------------------------|------------------------------------|
| 1. 1 hand bucket | 14. 1 toothbrush and scrub brush |
| 2. 3-4 swiffer flat mops | 15. 1 putty knife |
| 3. 2 “WET FLOOR” signs | 16. 3M HQ Quat cleaner # 25L |
| 4. 1 mop easy flat scrub tool | 17. Soft scrub gel with Clorox |
| 5. 1 Doodle Duster tool | 18. 3M glass cleaner # 20L |
| 6. 1 high duster | 19. 3M bathroom cleaner # 4L |
| 7. 1 dust pan | 20. Plastic waste basket liners |
| 8. 1 counter brush | 21. Doodle Duster cloth |
| 9. 1 green scouring pad | 22. Keys for paper towel dispenser |
| 10. 1 toilet brush and container | 23. Rags |
| 11. 6 rolls toilet paper | 24. Run sheets |
| 12. 3 bottles liquid soap | 25. Safety glasses |
| 13. 6 packages paper towels | 26. Gloves |

7-Step Cleaning Process

***REMEMBER: Knock and introduce yourself before entering occupied rooms.**

1. PULL TRASH/LINEN

- Remove liners from all waste containers. Damp wipe inside and outside of waste containers before relining.
- Remove soiled linen. Damp wipe linen hamper before relining.
- Check needle containers (change when $\frac{3}{4}$ full).

2. HIGH DUST

- High dust everything above shoulder level or out of reach.
Note: Never high dust near or above a patient.
- Include all adjacent rooms (i.e. restrooms).
- Go clockwise around the room so that no surface is omitted. Pay particular attention to lights, vents, and ceilings.

3. DAMP WIPE

- Wipe everything you are able to reach.
- Use bleach wipes for all surfaces except glass.
- Use glass cleaner to wipe interior and low-level glass.
- Start with the door and work around the room in a circular pattern.
- Be sure to include: wall spotting, light switches, door knobs, call buttons, telephones, wall moldings, dispensers, windowsills, and furniture.

4. CLEAN BATHROOM

- Start at the door and end with the toilet. Clean all surfaces and shower stall. Use a Johnny mop inside the bowl and wipe the outside with a cleaning cloth. Do not use the cleaning cloth on any other surface after cleaning toilet. Stock all paper supplies.

5. DUST MOP FLOOR

- Move and dust behind all furniture.

6. DAMP MOP

- Place **WET FLOOR** sign at the entrance before you begin.
- Start with the corner farthest from the door and work your way out.
- Mop out corners to prevent build up. Use the micro fiber mop system.

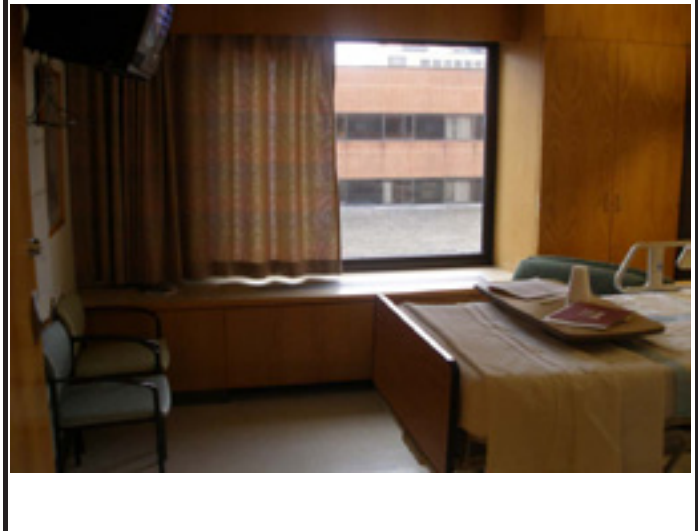
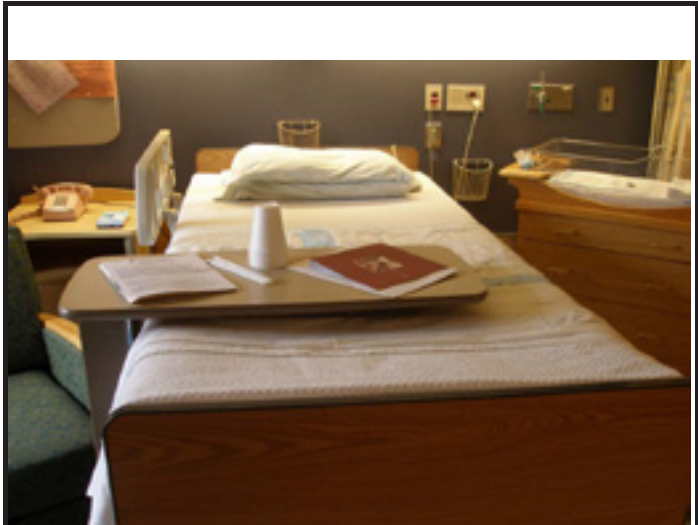
7. INSPECT THE ROOM

- Check sharps boxes, hand sanitizers, glove boxes. Replace as needed.
- Correct or report any deficiencies or needed repairs.

Checklist

Bassinet
Light over bed on (Top only)
Television Music Station on 15
Window Drapes open half way
2 guest chairs against TV wall (Fabric as shown)
1 Sleeper Chair by wardrobe (Fabric as shown)
Nightstand (As Shown)
Telephone
Clock (Wood Rim)
Artwork
White Board on Tack-strip w/2 Hooks
Glove Box (Hung on Wall)
Sharpes Container
Personnel Protection Supplies Box
Tack Board Over Nightstand
Kleenex Box
Diaper Bag Gift Bag
Disposable Under Garment
Plastic Squeeze Bottle
Ice packs
Feminine Napkins
Toilet Paper/Toilet Paper Holder
Blow Dryer
Soap
Towels (To Be folded and laid on Sink)
Gown (To Be folded and laid on Sink)
Socks
Garment Bag
Shower Seat
Paper Towels
Waste Basket
Soiled Linen Container

ROOM 3703
Date:
Service Tech:



COMMENTS:

APPENDIX IV. RESEARCH QUESTIONS FROM SURVEY RESPONDENTS

The following is a list of research questions that were considered most important by the survey respondents. The questions are grouped into several topic areas.

Consideration of Multiple Factors for Decision Making: HAI, Health, Environmental Effects, Cost, etc.

- How does a green cleaner compare to a conventional cleaner in killing germs? Are there any harmful residuals left behind? Are they safe to use around patients with respiratory issues?
- Which product disinfects better? Which costs less? Which can you use less water when using?
- How does a green cleaner compare with a virucidal agent? What is the cost difference between green and standard cleaners? What is the impact on the environment?
- Can green cleaners appropriately kill germs and prevent secondary infections? Is there any cost savings from their use and, if so, is there any negative potential cost to patient and staff?
- Is the use of green cleaners effective for hospital staff in the long-term prevention of diseases or conditions caused by chemical exposure?
- Are green cleaners less expensive (including all materials needed to be used with it, i.e.: reusable cloth, disposable cloth, reusable mop, disposable mop), but able to perform or outperform currently used cleansers?
- Does the cleaner fulfill the intent for which it was used? Is it safe for patients, workers, environment?
- How does green cleaning relate to health issues? Does green cleaning clean as well as the chemical alternative?
- What risks and benefits exist after implementation of green cleaning techniques?
- You cannot look at just one...that is the balance of decision making.
- Cleaners are chosen for what they kill, so show me a greener cleaner that's comparable to a quat in terms of price, what it kills and how quickly it kills.
- Balance the contradictory requirements of Infection Prevention with green cleaning hazard and toxicity reduction.
- Green cleaning effects on human health, the environment, and costs.
- What is the effectiveness of green products and what are their long-term effects? How do they compare to traditional cleaners and what is the cost effectiveness vs. long term effects?
- How effective are cleaners that are safe for children's areas (Peds, NICU, doctors' offices)?
- Gaps particularly with the human health studies of green cleaners, worker exposures to green cleaners, and comparisons using evidenced based systems- Carling method for example- to test critical touch points -vectors for HAI- using CMS testing points or other- to prove effectiveness of cleaning products or methods. Additionally, the cleaning methods, education for front line staffs - standard procedures for cleaning patient room- needs to be underscored in a green cleaning study. The study should find that green cleaning needs to be the norm so that healthcare evolves to a facility cleaning plan that mandates the use of certain products and methods, and does not allow use of other types of products or methods (or advises on using alternate products or methods when possible) as part of the chemical hazard communication plan and also to directly address OSHA worker occupational healthcare concerns or issues.

- Does the U.S. really need to use germicides, or can we clean with less pesticides by using microfiber or electrically charged water? How do cleaning chemicals actually affect the environment, patient and staff at a hospital?
- Which product cleans as well as bleach without the health hazards?
- How effective and cost-effective (ROI) are certain non-product solutions to cleaning and sanitizing/disinfecting of surfaces and products--UV light, ozone, etc.?
 - ▶ (1) Are there specific areas in healthcare where a green cleaner can be identified to use safely and effectively?(2.) Will there be evidence-based practice “case studies” that prove that green cleaners are as effective as commonly used hospital chemicals in specific infections?(3.) Is there a cost effective use for green cleaners in a hospital setting?
- What are the most effective cleaners with the least toxicity for cleaning areas with high infectious potential?
- How does a green cleaner: improve cleanliness and control of HAI, reduce costs, improve health of staff and patients?
- Conduct research to determine the most cost effective means of green cleaning.
- How do effectiveness of site-generated cleaning solutions compare with bottled cleaners from ecological and sanitation standpoints?
- Green chemicals to reduce harm to employees and environment.
- Starts with research and development together to bring us to better methods and products for killing germs, but less toxic to our environment we are working, and living, and for those who are the caregivers and the patients they take care of. Yes, cost is always there to be measured, but lasting results of greening is the reward.

HAI Prevention

- Addressing disinfectants as they relates to a green program.
- How do facilities measure ‘clean’? Using these measurements, how does ‘green’ cleaning compare to current or standard cleaning practices? Compare in terms of 1) efficacy and 2) cost.
- Provide information on specific green cleaners that kill bacteria and organisms that are unique to a hospital setting.
- How effective is the green product? What is the minimum exposure time of the product on the surface to effectively kill germs?
- The one you provided is perfect! I believe this is the “last or next frontier” for developing green cleaners.
- Are there any green cleaners that will effectively kill the C-Diff spores on inanimate surfaces?
- What is an acceptable level of cleanliness where the product is used?
- What impact, if any, does “green” cleaning have on HAIs? What green products are the “best” to prevent or decrease HAIs?
- Evaluate effectiveness of green cleaners in prevention of disease transmission.
- Is there a green disinfectant? Is there specific training out there on avoiding cross contamination?
- How can chemical-free products effectively replace traditional chemical-based cleaning agents in a healthcare setting?
- How does a green cleaner compare to a conventional cleaner in killing germs? What is the kill time?
- How does a green cleaner compare to a conventional hospital disinfectant?
- The question above is good and we need to make sure it kills the germs that we come in contact with.
- How does a green cleaner compare to a conventional cleaner in killing germs? What are the long term effects of using green cleaners in minimizing germs in hospitals?
- How does a green cleaner compare to conventional cleaners in effectiveness of killing germs? (6 duplicates not listed)

- How does a green clean compare to a conventional cleaner in terms of effectiveness against drug-resistant organisms?
- Will there be a technology that will clean with steam that can kill micro-organisms?
- How do green cleaners compare in their nature of effectiveness for the purpose they were meant?
- What is the best green cleaner to kill MRSA or what is the best disinfectant?
- Can we measure any higher level of bacteria/viruses on surfaces cleaned with green methods?
- How does a green cleaner compare to a conventional cleaner in killing germs? How do various green cleaners compare in performance to their non-green competitors?
- Need to identify how effective they are compared to the usual type of current chemicals.
- Finding a green disinfectant
- How does using green products reduce healthcare associated infections?
- I believe the question you posed in the text of the question is good. How green cleaners compare to conventional in killing organisms, virus, HIV, and HBV...etc. This is very important to infection control as well as the safety of use and environment.
- 1. What cleaning practices and standards measurably prevent HAIs? 2. How do viruses and bacteria adapt to cleaning products and practices--do cleaners become ineffective after a time?
- How effective are green cleaners vs. other conventional cleaners in terms of their anti-microbial efficacy?
- Prevalence of nosocomial infection rate within a facility before and after the incorporation of green cleaning alternatives.
- What is the kill time of this green cleaner? How much time does it take to clean a room with this green cleaner as compared to a conventional cleaner?
- Control of C Diff and MDROs- compare effectiveness of green vs. conventional cleaners. What areas need what cleaners- if green cleaners cannot be used in all areas, which areas can they be used in?
- How effective are green cleaners at reducing microbial contamination? How do green cleaners and processes compare to conventional cleaners in reducing microbial contamination? Under what circumstances are green cleaners effective against C. Difficile contamination?
- Are there green cleaners that will kill MRSA?
- Greener products that have equally strong kill rates / comparable or reduced dwell time.
- What green cleaners are acceptable substitutes for sanitizers/disinfectants?
- How effective is charged water as a disinfectant?
- I like the question stated here.
- What is the evidence that green cleaning works just as well as the toxic chemical based product?
- Certainly bio kill rate comparisons, and under similar use conditions.
- How do green cleaning products and techniques compare to standard cleaning methods in treating HAIs?
- How do green cleaners compare in terms of efficacy in cleaning (including staff effort/time)?
- How is green cleaning more effective and efficient than conventional cleaning methods?
- Effectiveness of so called green cleaning chemicals in comparison to existing cleaning chemicals. Review non-chemical solutions to cleaning.
- Comparison between the effectiveness of green products and their equivalent non-green products.

Environmental Impact

- Evaluate long term toxicity to the environment.
- Evaluate the effects of greening on the environment.
- Since the cleaning material is a biocide or pesticide, how long will its effects last? What is the proper disposal of the cleaner, specifically on wastewater treatment?
- Environmental impact.
- Are there alternatives being developed for the plastic trash bag? Isn't oil used for producing these bags?

- How are green cleaners processed by current waste water treatment facilities?
- What is the total environmental impact of green cleaners and process (e.g. energy use, products, disposal and long-term impact considered)
- How does a green cleaner impact my eco-footprint?
- Provide database of fundamental environmental impacts of the status quo cleaner constituents, and new (green) constituents.
- What is the difference of impact on disposal/discharge into the environment between traditional and green cleaners?
- What ingredient(s) in fragrances are responsible for indoor air quality impact?
- I would like to understand why traditional cleaners make people sick (is it respiratory? something else?) as compared to green cleaners.
- How do peroxide based cleaners compare to bleach or alcohol based cleaners? Do staff have less complaints (respiratory) when using peroxide based cleaners when compared to bleach or alcohol based cleaners?
- How does a green cleaner compare to a conventional cleaner in improving indoor air quality?
- What is the difference in chemical exposure to healthcare staff, patients and visitors between using green cleaning practices and traditional methods?

Health Effects

- Is there any chemical absorption of the cleaning chemicals for neonates due to their immaturity?
- How much faster do patients heal in a hospital that uses green cleaning products? What type of health impacts suffered by healthcare staff are directly related to cleaning programs?
- Evaluate worker musculoskeletal injuries in relation to green cleaners and methods to prevent injuries.
- How does the use of green cleaning products improve patient care?
- How important is the use of green chemicals by healthcare to the customers we serve?
- Can the use of green chemicals be definitively linked to improved environmental health?
- How does green cleaning affect the health of the hospital staff?
- Will the product in question be odorless?
- Who evaluates all the products for their toxicity?
- Additional information on health of staff and patients with use of green cleaners.
- How does the using green products contribute to the health of associates?
- 1. bleach versus green cleaner
2. water use reduction
3. indoor air impacts
- How does the shift to green cleaners affect worker safety, health and other work conditions?

Implementation

- How to combine green cleaning with good mechanical ventilation?
- Why do hospitals still use bleach based cleaning products when hydrogen peroxide based cleaning products are just as effective against infectious diseases?
- How to convince and implement healthy cleaning in an organization.
- Evaluate effective worker training on use of green cleaners.
- How can green cleaning be implemented without increasing and/or reducing costs? What is the priority of green cleaning for hospital CEOs; how does it rank against ACHE Top CEO agenda?
- What is the best way to educate everyone about using green cleaners?
- Identify when certain antibacterial/antimicrobial agents are needed. Define acceptable surfaces and the cost of maintenance for them.
- How do different stakeholders best access information about green cleaning?
- How do we shift the thinking that EVS personnel are only housekeepers and make the culture shift that they are Infection Prevention Specialists?

Cost/ROI

- How do I quantify the dollar savings from using green products, other than if it is just cheaper to buy?
- How do green cleaners compare in effectiveness?
- Does a green cleaner or process reduce costs?
- I think the quality and ROI questions are important.
- How do various green cleaners compare in cost to their non-green competitors?
- Disposal costs of green cleaners. Size and packaging of green cleaners to reduce storage and disposal costs.
- How does using green products compare to conventional in costs?
- What are the cost savings when using green cleaning vs. traditional cleaning process? What green cleaning process is best for use in hospitals?
- How can the ROI analysis reflect sustainable return on investment for green cleaning? (i.e. improved patient outcomes, etc. that do not usually get included in cost analysis)
- LCA and cost analysis between conventional cidal cleaners and their green counterparts.
- What is the expected ROI per bed for a ____ type of hospital to transition to green cleaning?
- What products are most effective (i.e. cost vs. frequency)?
- How can green cleaners which are proven to be effective in killing germs be more cost effectively produced?
- General cost comparison between green regular cleaning.
- Conduct research ROI for implementing green cleaning in health care facilities.

Standards/Evaluation Methods

- How do licensing agencies decide which cleaners are acceptable and how difficult is it to have a licensing board accept green cleaners?
- How can we measure the effectiveness of a cleaning process (mechanical cleaning action) separate from the applicator or the agent --so that effectiveness is not inappropriately/incorrectly attributed to the cleaner--whether green or not?[Until there are data on this issue-- I do not believe many of the other questions can be answered--best we have right now is a method of evaluating thoroughness of cleaning that is NOT dependent on the agent--e.g. Carling evaluation method]
- Develop a way to rate green certified chemicals on a comparative scale to see which is greener in terms of doing less harm to the environment. Cleaning effectiveness vs. environmental impact.
- Develop standard methods to measure and evaluate effectiveness of different green cleaning products and practices.
- Is there a standard for green cleaner comparisons?
- What criteria are appropriate to determine the cleaning ability of a cleaner?

Definition of green cleaning

- Identify the definition of green cleaners.
- Explain the different between using green products vs. using non-green products in the healthcare environments. What is considered green cleaning?

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