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Features

TRANSITIONING FROM TRADITIONAL TO GREEN CLEANERS: AN ANALYSIS OF CUSTODIAN AND MANAGER FOCUS GROUPS

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ABSTRACT

Custodians represent one of the largest occupational groups using cleaning agents, and yet their voices are infrequently heard in relation to the introduction of "green" cleaners and the laws regarding environmentally preferable products (EPP). This study reflects worker voices on use and effectiveness of chemicals, as well as incentives and obstacles for green cleaning programs. Sixty-four custodians and staff participated in 10 focus groups. Data were entered into Atlas Ti and the constant comparative method of qualitative data analysis was used to identify themes. Themes included satisfaction in a "well-done" job, more effort required for job, lack of involvement in EPP selection process, EPP's ease of use for workers with English as a Second Language (ESL), misuse of disinfectants, health complaints, and need for training. This study shows that custodians have a voice, and that improved communication and feedback among all the stakeholders are needed to make the transition to green cleaning more effective.

Keywords: green cleaning, custodian, environmentally preferable products, substitution

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The building cleaning industry in the United States employs 4.2 million as custodians or in related occupations [1, 2] and uses an estimated 6.2 billion pounds of cleaning chemicals annually, with $180-500 billion in economic activity [3]. A Danish national survey found cleaning industry employees are among the most exposed to hazardous chemicals of all occupational groups [4]. Custodians have the fifth highest overall injury and illness rate [5] and represent one of the largest occupational groups using cleaning agents [6]. Traditional cleaners are associated with both acute and chronic health problems [7], including asthma [8-20], dermatitis [21, 22], birth defects, reproductive disorders [17], and brain damage [23]. Recent studies have focused on cleaning product evaluation and task-based assessments to identify workplace interventions for improving health [19, 24].

The formulation of cleaning products is transforming rapidly as new environmentally preferable chemical ingredients are taking the place of traditional chemicals. The federal government has defined "green" products, more accurately called "environmentally preferable products" (EPP*)*, as products and services that "have a lesser or reduced effect on human health and the environment when compared with competing products or services that serve the same purpose" [25]. Continued growth in the green economy is expected since "green" cleaners account for only about 23 percent of cleaning chemical sales in 2010 [26]. Exposures to cleaning chemicals among custodians are both pervasive and greatly understudied, presenting an enormous opportunity for reductions in exposures to hazardous materials under the safer alternative movement.

In the United States, at least a dozen state governments have adopted precautionary laws and policies to substitute safer alternatives for toxic cleaners in educational facilities and state buildings [27]. School communities, advocacy organizations, and many state health departments have developed an industry-wide approach to the implementation of green cleaning programs in schools to improve indoor air quality in their buildings for teachers, staff, custodians, and students [28-30]. The health care sector is also implementing green initiatives that reduce chemical exposures to both workers and vulnerable patients [31-33]. Senier and others [31, 35] describe effective models for "building bridges" among workplace stakeholders during the implementation of a green cleaning program. Connecticut state law 07-100 requires that state agencies use EPP (with third party certification by Green Seal or EcoLogo) to minimize potential impacts on human health and the environment. Disinfectants, sanitizers, and antimicrobial products are not regulated under the law.

To date, there are no studies in the literature that have characterized custodians' and managers' perspectives as their institutions transitioned to meeting a state-level green cleaning mandate. This paper reports on the results of focus groups of custodians regarding their use of cleaning chemicals, their health, and transitioning to EPPs. All aspects of the study were approved by the University of Connecticut Health Center (UCHC) Institutional Review Board (IRB #10-050).

HISTORY OF UNION-COMMUNITY PARTNERSHIPS IN CONNECTICUT

The study partners were the Connecticut Employees Union Independent, an affiliate of the Service Employees International Union (CEUI-SEIU); the Connecticut Council for Occupational Safety and Health (CTCOSH); the Coalition for a Safe and Healthy Connecticut (CSHC); facility departments and environmental health and safety offices (EH&S) within state agencies; and researchers at the UCHC.

ConnectiCOSH is a nonprofit statewide organization which helps unions, individuals, and communities obtain healthier and safer working conditions. ConnectiCOSH is a lead partner in CSHC, a broad and diverse state coalition to promote safer alternatives to toxic chemicals.

CEUI-SEIU Local 511, has taken a leading role in providing support to its members on the green cleaning law. CEUI was one of the first unions to join CSHC. The union formed a special committee, the "Clean with Green" Working Group (Working Group), composed of their educational director and the chief stewards from five large state institutions. The group recognized the need to improve the education and delivery of a green cleaning program across state institutions. Therefore, this group committed extensive time to give guidance on the research questions of this study during the grant application process with UCHC.

METHODS

The study used a community-based participatory research approach to jointly address study objectives, research methods, health and safety concerns, and data analyses and interpretation. A partnership agreement was developed that outlined the goals of the study and general roles and tasks for the research team (CEUI-SEIU, CSHC, CTCOSH, and UCHC). These partners met each month to discuss all aspects of the study. During these meetings, all survey instruments were generated, worker recruitment strategies were developed, and study results, fact sheets, and manuscripts were reviewed. In addition, when needed the chief stewards and members of the Working Group discussed related study issues with the CEUI-SEIU education director, who then communicated information to the UCHC research team.

Custodial Population

From their membership of 4,000 state employees, the Working Group identified 456 custodians and 49 cooks (with cleaning and disinfection job duties) who were working with EPP, disinfectants, and/or traditional cleaning products, for a total potential sample of 505 from six institutions. The number of custodians ranged

from 16 to 166 per institution. UCHC research staff contacted EH&S staff from each institution to explain the study and request their participation. EH&S staff from each institution submitted a participation letter to UCHC to document participation approval for the study. Green cleaning programs at these institutions varied in duration, ranging from six months to five years.

Focus Groups

Ten focus groups of union custodians, EH&S managers, cooks, and facilities staff were conducted to ascertain the perceptions of cleaning chemical use, health, and transitioning to EPP. Five state institutions participated in this phase of the study, including three college campuses, a medical center, and a residential facility for individuals with intellectual disabilities.

Custodial Focus Groups

Nine focus groups were conducted with custodians. Only one institution included food service personnel and custodians together as participants. The principal investigator used a script to lead the discussion with English-speaking custodians, and two members of the research team recorded notes (UCHC member and Working Group member). One focus group was done with Polish-speaking custodians and one was done with Spanish-speaking custodians. Staff from CTCOSH (Spanish-English) and a member of CEIU (Polish-English) facilitated these focus groups. Focus groups were conducted on work time (seven during first shift and two during third shift). UCHC research staff coordinated with the managers and supervisors from each institution to request release time from work for custodians to participate in the focus groups. The supervisors assisted UCHC research staff with some of the focus group logistics (e.g., meeting room locations, reminding custodians about the meeting).

Recruitment of custodians targeted opinion leaders of the facilities using a sociogram approach to identify people who co-workers reported as being influential. Members from CEUI-SEIU serving on the Working Group identified opinion leaders from their institutions to participate in the focus groups. First, the research team developed a flyer describing the study and the purpose of the focus group. Working Group members from each institution posted flyers on their campus to provide general information about the study. A description of the study was also placed in the union newsletter. Working Group members then discussed the study with five to10 fellow custodians from different areas of their campus, and asked them who they talked to about work-related issues. From these conversations, a list of potential opinion leaders was developed for each institution, and these workers were asked to participate in the focus groups.

Management Focus Groups

Focus groups of facility managers, supervisors, and EH&S staff were conducted separately from those of custodians. UCHC research staff invited each EH&S staff and facility manager to participate in a focus group. Each institution sent one representative to UCHC to participate in this focus group.

Focus Group Script

A semi-structured focus group script was designed to 1) characterize perceived incentives and barriers to adoption of EPPs; 2) compare chemical use and best practices; and 3) consider issues among bilingual worker populations. The script was developed by university faculty experienced in survey and focus group script design. It was refined after several reviews by the Working Group to ensure comprehensiveness, relevance, and understandability of questions. Participants were assured of individual confidentiality of the discussion and were asked not to disclose the discussion outside of the focus group; names were not used during the focus groups so that there would not be a record of the specific individual speaking on the transcripts. Transcripts were reviewed only by the study team. Polish and Spanish transcripts were translated by a certified translation service (UMASS-Amherst).

DATA ANALYSIS

Focus groups were digitally recorded, professionally transcribed, and reviewed for accuracy. Transcripts were imported into ATLAS Ti [36], a software package designed to handle unstructured qualitative data to assist in reporting recurrent themes, links among the themes, and supporting quotations. Transcribed data were analyzed using the constant comparative method of qualitative data analysis to identify recurrent themes until "theoretical saturation" was achieved; that is, no new themes emerge through subsequent data analysis [37, 38]. Coding used the integrated approach [39], where a provisional "start list" of codes based on existing scientific literature and the experience of the team [40] was refined during analysis from subsequent interviews. The final version of the code structure was based on a review by two researchers and two community members (one union and one consultant). Two research team members independently re-coded the transcripts based on the final codes, and where discrepancies occurred, data were re-coded to consensus. Coding was performed on each focus group, and then reviewed as a combined dataset. The software allowed identification of the focus group, which allowed for differentiating custodians from the managers, and from the ESL group. Statements from each transcript were rated as positive or negative to determine if there was a significant difference in attitude between the focus groups.

Collection of Material Safety Data Sheets

CTCOSH and UCHC research staff contacted EH&S departments from each institution requesting material safety data sheets (MSDSs) for all cleaning products and disinfectants. The purpose of the collection was to determine the number and type of products that were available to custodians (e.g., EPP or traditional) at each institution. Some institutions provided a list of product names, and others provided copies of all their safety data sheets. MSDSs do not contain information regarding EPP status. CTCOSH staff used websites from Ecologo and Green Seal to identify EPP from each institution. UCHC staff reviewed the list. There is no widely accepted definition for "green" cleaners. In this study, chemical products discussed in this paper are defined as follows:

1. EPP are cleaning products that are certified by third-party independent organizations, specifically Green Seal (GS) and EcoLogo. These organizations evaluate products according to health, environmental, and efficacy criteria by using the International Organization for Standardization for environmental labeling (ISO 14020) and for third-party certifiers (ISO 14024). The standards are product-specific. For purposes of this study, EPP is defined as an industrial and institutional cleaner certified by Green Seal under the GS-37 Standard (general purpose, restroom, glass, and carpet products), GS Standard-40 (floor care products), and Ecologo standards 110, 112, 146 and 147. Under standards, such as GS-37, the chemical concentrates are used in a closed dilution-control system to minimize worker exposure, chemical usage, and transportation costs. In 2008, GS updated GS-37 with new health criteria by prohibiting ingredients, such as asthmagens and endocrine-disrupting chemicals (e.g., phthalates), a significant improvement particularly in relation to worker exposures.
2. Traditional cleaning products are cleaning products that do not contain a Green Seal or Ecologo certification.
3. Disinfectants are registered by the U.S. Environmental Protection Agency (EPA) under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA). EPA does not allow disinfectants to be evaluated or certified by third-party organizations. Typical ingredients in traditional disinfectants include phenols, quaternary ammonium chloride compounds, alcohols, and sodium hypochlorite (bleach).

RESULTS

Focus Groups

Sixty-four workers participated in the focus groups (see Table 1). The participants were typically older, with long seniority, and ethnically diverse (see Figure 1). English was the primary language for 62 percent of the participants,

Table 1. Focus Group Location and Number of Participants per Focus Group (n = 64)

Focus Group Location	Number of Participants
Site A	
Focus Group 1 (Spanish)	7
Focus Group 2	3
Site B	
Focus Group 3	6
Focus Group 4	7
Site C	
Focus Group 8 (Polish)	9
Focus Group 9	7
Site D	
Focus Group 5	7
Site E	
Focus Group 6	6
Focus Group 7	7
Managers/EH & S Staff (combined sites)	
Focus Group 10	5

Polish for 19 percent, and Spanish for 19 percent. Participants had a mean of 12 years of education. Fifty-nine workers participated in the custodial focus groups and five participated in the management/EH&S focus group.

Seven salient themes emerged related to the transition from traditional cleaners to EPP: satisfaction in a "well-done" job, more effort required for job, lack of involvement in EPP selection process, EPP ease of use for workers with English as a second language (ESL) , misuse of disinfectants, health complaints, and need for training. A detailed qualitative assessment of the focus group transcripts revealed that of the comments on EPP, 68 percent were negative, 22 percent were positive and 10 percent were neutral.

Theme 1: Custodians Feel Pressure to Do a Job Well

Custodians reported pride in their work ("We take pride in our work. We don't rush because it's slow"), and they are committed to providing a clean and healthy environment for their customers. When asked to describe "a job well done," their responses included: "The smell and happy kids . . . and happy bosses . . . you walk in and you get the wow." and "When Mr. Clean is standing right next to you with a smile." Custodians reported some increase in building occupant complaints

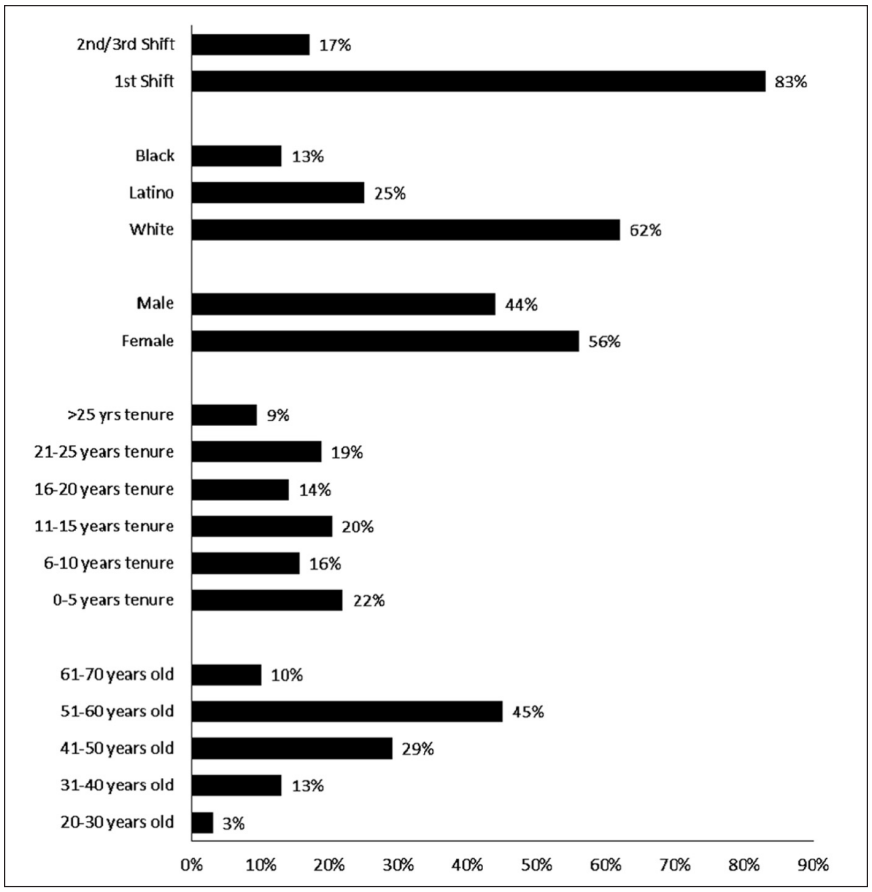

Figure 1. Focus group demographics.

("Everything now is like dull and . . . dingy. Everything's just so dull. You walk into a dorm and it's all, it looks like a dust ball exploded you know 'cuz they're so dull"). Supervisors appeared to recognize that the custodians worked hard to produce a clean and sanitary environment ("Something right there in the hall . . . they couldn't get it off, so I tried and I can't get it off so. . . . At least now I know we seriously can't get it off. It just gets to the point now we're spending too much time on this. . . . And then they're [the custodians are] frustrated and walk away from it").

The custodians commented that EPP take more time to work, and as a result there is greater pressure to work quickly and efficiently to clean their assigned areas during their shift. Results were thought to be good with some products ("I don't like that it . . . can take you a little longer with the stuff we have

now but, but that [green floor cleaner] works good on the floors . . . all my floors look like glass"). Areas such as bathrooms and locker rooms are in high use and custodians must clean these areas quickly, particularly areas used by the opposite gender ("So you really, really had to . . . double-dose it, and spray, clean, spray, clean, where when you did the [traditional cleaner], it was spray it once, clean, the toilet was clean").

In almost all cases, custodians commented that smell and shine are critical indicators of a "well done job." For example, custodians judged a wax based on how long it held its shine ("They only shine . . . the first day that you put the wax, then that's it"). Others expressed that the shine was important for their occupants ("And it's hard 'cuz . . . you know we like our kids for the most part . . . and we don't want them to live in a dump. . . . Shiny means a lot").

On the other hand, custodians noted that building users associate a "good" smell (such as from fragrance, odorizers, deodorizers, or bleach) with a clean environment or recent cleaning, and many of the custodians also thought this ("They'll come to you and say, excuse me can you clean this shower for me? And you be like, it's clean. I already cleaned it but I'll do it again so you can see me do it. But . . . it's already been cleaned, you know"). Other custodians reported that they received compliments from students for a clean shower after the custodian used bleach. In one dormitory, custodians trained their students to know that if they smell "orange" the bathrooms are clean, to try to improve acceptance of the EPP. Custodians reported that the newer products have less fragrance and therefore they do not receive as much praise from building occupants after they have cleaned a room. In some cases, the institutions are placing "air fresheners" (odorizers) in the bathrooms to release fragrance in the air.

However, custodians noted that there are situations where the absence of a smell is preferable ("I always say, you know, you don't want the bathroom to smell like urine, but you don't want it to smell like flowers and urine. So we like to try to clean it correctly the first time"). Custodians reported exercising special care in patient areas. Nurses complain that the smell of cleaning products is too strong for patients who may be on certain medications or have respiratory ailments and they tell the custodians to close the door of the room they are cleaning. As a result, the custodians cleaned only when the patients were not in the room or used plain water, or very dilute solutions instead of stronger disinfectants. Some custodians suggested using fragrance-free products in all environments (not just in health care settings).

Custodians thought informing building occupants that EPP were being used would help in understanding why fragrance and shine levels were different ("I think I wish we had focused more on the customer, the building occupants, to let them know what was happening. For them to understand that the clean scent wasn't going to exist anymore . . ."). For example, a custodian described that in one institution vendors placed tent cards on tables explaining the new cleaning system, and other custodians suggested broadcasting notices including websites or televisions in the cafeteria.

Theme 2: Custodians Reported Using More Physical Effort for the Same Effect with EPP

Some custodians reported that they believed traditional cleaning products were more effective than EPP, particularly powdered cleansers and bleach ("I'd rather see the old traditional cleanser. For example, for some surfaces like sinks . . . like before we had the [powdered] cleanser . . . did a good job . . . now we don't have, we have to do more hard working").

Some custodians commented that the EPP kept surfaces clean-looking only for a short time ("With the new stuff, I clean it and the next, I turn around and it's dirty again") and required more physical effort to reach an acceptable standard of cleanliness ("You've gotta scrub, and scrub, and scrub").

Some custodians stated that EPP worked for the most part and were worth it for environmental reasons ("Obviously they don't all work as well as the older stuff, you know, that we're used to, that we grew up with, but just to try to be a little more environmentally safe and conscious about it, that's why I'm doing it. And they work for the most part").

Custodians also reported greater muscular-skeletal complaints related to EPP. The complaints may be due in part to the increase in physical effort required to do the same task with a less effective product ("My shoulders are really hurting"). Management also commented that more physical effort was necessary with EPP ("Now it's three times [applying the cleaner]. That's why the staff is getting hurt more I think"). One situation involved having to buff floors much more frequently with an EPP wax, which resulted in back stress from having to carry the buffing machine up and down stairs multiple times a week rather than quarterly or less.

Theme 3: Custodians Lack Involvement in the Decision-Making Process for the Selection of EPP

A feedback mechanism is a process built into the organization that allows individual users to provide their reaction, criticism, advice, or opinion of EPP to supervisors, purchasing agents, EH&S staff, or sales representatives. Few focus group custodians reported a clear and/or effective feedback mechanism within their organization for the transition from traditional to EPP. The custodians in the focus groups stated that since they used the cleaning products, they were the most appropriate ones to evaluate product effectiveness and provide feedback. However, they commented that they were largely excluded from the purchasing decisions ("Tell the truth. What they really need to do is let the person [who works] with the chemicals order the right chemicals and do the right inventory. How you gonna know what you need when you don't work with it?").

In contrast, managers perceived that they were receptive to feedback on EPP ("Yeah, the housekeepers were part of the decision. . . . We try all of them on different floors, let them try them out and tell us what they thought"). Most agencies had a very limited pilot of EPP before they were purchased for an entire

institution. The purchasing decisions were viewed by custodians as unsystematic ("Ours was I think more like a trial and error. They'd get a gallon from one of the vendors, try it. Somebody would try it in one of the buildings and get a report back"). In addition, there was limited communication among the workers that products had been pilot-tested by custodians at their facility or other institutions.

Workers estimated that the transition to green cleaning takes at least six months to a year. The custodian participants recognized that costs were a critical factor when making purchasing decisions (". . . because there was some products that were good and we said this is good and they said this is too expensive right off the bat"). Facilities and EH&S staff thought EPP saved money, in part due to purchasing fewer products.

Food service personnel were identified as another stakeholder group using cleaning products; however, only one institution included these workers in a focus group. Our results are limited but indicate that different issues, such as health code requirements, influence the adoption of the use of EPP for these workers ("Basically there are food service codes and non-food-service codes. Basically, in all the buildings they use spray bottles with bleach water. Diluted bleach water, it's just a disinfectant to sterilize everything").

Theme 4: Custodians Who Have ESL Found "Green Cleaners" Easier to Use

Custodians who have ESL typically spoke Spanish or Polish. Supervisors or co-workers often function as interpreters during training and on the job. Custodians with ESL reported that they learn best by working side-by-side a co-worker or supervisor so that they can see the cleaning protocols firsthand. Custodians with ESL reported that green means health and everything related to helping clean the air. They commented that they know an EPP because all the EPP have a special code or number to identify them easily ("By the bottle you can tell. Each bottle has its number") Certain tasks with EPP are easier now for custodians with ESL ("I think it's a lot better organized now with the dispensers that are used with measures"). These workers explained that they were able to work more efficiently with the new dilution stations ("We clean faster. You see, they're [product bottles] diluted each—with water. It's easier, now").

Despite the diverse languages spoken by custodians, most training programs and written materials are in English, although product labels and instructions sometimes include Spanish. Custodians noted that the MSDS are only in English, and the printing can be so small and complex that they were not always useful even for individuals fluent in English. These custodians typically go to their bilingual co-workers to help them understand a component of their job. In some cases, custodians expressed that bilingual supervisors were very helpful. However, there is usually only one bilingual supervisor for an entire department, which limits access ("It's kind of hard too because there's only one supervisor that speaks that language. That supervisor can't be in all places at once").

Custodians with ESL noted that EPP training lacked information on the health effects of EPP ("I think we needed a little more—the consequences, what are the consequences on oneself . . . the human being . . . what can have an effect on us or not. But I think we need a little more"). In addition, custodians commented that some changes were protective of their health ("And there was also a change, that before we used to use hot water, so all the fumes of the chemicals, we used to breathe in. And now some years ago they told us not to use hot water. We use cold water, and so we don't have the problem of breathing in those fumes") Custodians reported that posters with pictures and symbols were very helpful ("Well, English is my second language, but like I said before they will explain in the poster that we have, because they have the picture of the chemical with the machine or the mop and the number. So, if you don't know English you see the number of the product and the use that they are doing").

Theme 5: Custodians Stressed the Importance of Disinfectants but Need More Training on Proper Use

Custodians consistently stressed the value of disinfectants to protect the health of the building occupants ("It's effective and it'll kill germs . . . because I like to kill germs. Nobody getting sick"). Bleach was a favorite product, and participants believed it killed all bacteria and viruses. The use of bleach in the workplace has been reduced with the introduction of EPP, and institutions have established policies for bleach use (for example, it can only be used when students are not present in the building or for cleaning mold in showers). In addition, aerosol spray cans have been reduced in most workplaces and replaced with an all-purpose cleaner.

Custodians use disinfectants on many surfaces. The frequency of disinfectants use is higher in certain areas, such as bathrooms, hospital patient rooms, gyms/locker rooms, and food service areas. ("We use it for the floors. We use it for washing the beds and the tables and the walls. I use it for most. For clean the toilet, for clean the sinks, you know"). One custodian reported spraying disinfectant in the air because he/she believed it would kill germs in the air and reduce the spread of illnesses. Custodians explained that they do not have time to clean before disinfecting surfaces or to properly observe dwell times (one to ten minutes). In some cases, work practices and products have changed to accommodate the work pressure of getting the job completed in a timely manner.

In addition, custodians used disinfectants as cleaners ("I just use the disinfectant spray with water, mixed with water with the spray and I use it for clean. I don't have any problem, nobody complain, you know"). Some custodians thought the disinfectants were part of the green product line because the products were introduced at the same time.

Health complaints were reported by custodians when using some disinfectants, and work practices were changed to reduce symptoms. Many custodians changed their disinfectant application method from spraying it on the surface to spraying or

pouring it on a rag ("Right now, as of last week, I had to change over to pouring it because right now as I spray it to disinfect certain areas, you know, some of the windows and stuff, I start coughing").

Theme 6: Custodians Reported Health Complaints for Both EPP and Traditional Cleaners

Custodians reported health effects related to cleaning products but did not always differentiate between EPP and traditional products. There was confusion as to which was actually an EPP; most custodians thought that they were using only EPP. Most institutions continued to use some traditional cleaners as they were transitioning to a green program. Also, manufacturers have lines of "green" cleaners that include noncertified cleaners. Custodians also discussed the importance of keeping building users healthy, and that this influenced what cleaners they used in the workplace.

The most common and severe health complaints related to cleaning products were respiratory conditions such as difficulty breathing, coughing, and gagging. These symptoms were reported for both traditional and EPP. The custodians made comments such as "It takes your breath away" or "it makes you gag" for certain products. Some workers also acknowledged that traditional cleaners were harsh and strong, and bad for health. For example one custodian reported that a noncertified graffiti remover "could knock out five custodians with one spray. And it kills roaches."

A few of the custodians mentioned that they had developed sinus problems or asthma since working with the EPP lines. Part of the problem was attributed to working in enclosed areas with poor ventilation such as basements, shower stalls, or elevators ("Yeah, in our place it's the whole basement. In the basement there are no windows, no windows whatsoever. So, anything you do there, you're stuck").

One worker reported that the traditional cleaner used for stripping made her very sick with headaches, but she kept working because she did not want to lose her job ("When I use it long time I was sick. I was sick. You know? . . . when I started doing the floor . . . my eyes was red, I got headaches, you know, I have to put a mask because I can't smell other that. You know, it make me sick").

Theme 7: Custodians Need More Support to Adequately Transition to Green Cleaning

Custodians reported some type of training or orientation related to green cleaning, with considerable variation. Vendors trained all the custodians at some institutions; at others, vendors trained lead supervisors, who in turn trained the custodians, or vendors trained in cooperation with EH&S staff. Many of the custodians stated that the product posters were very useful.

Custodians reported disappointment with the quality of green cleaning training (one noting that the entire training was "Here's a mop and a bucket"), with training time varying from a few minutes to two hours. However, the supervisors reported

the training was appropriate in content and quality ("They offer complete training programs . . . the vendor is willing to come out, training all your shifts. . . . I think your vendor will give you excellent training").

The most frequently mentioned training topic was the use of mixing (dilution control) stations. The dilution control stations were installed by the vendor and were designed for a specific product line. Management expressed frustration with custodians who did not use the stations correctly: "We ended up going with a system that mixes the chemical itself so there's no guess work involved. I thought that was a real positive, although they still find ways to manipulate it").

However, custodians stated that the dilution control systems were not consistently efficient. In part, the mixture of the cleaning solution depended on the water pressure of the given faucet, since it varied the ratio of chemical to water ("Sometimes it comes out extra sudsy." "Or it comes out pure water"). In cases where a larger quantity of chemical was mixed in, the solution left surfaces sticky.

Custodians also intentionally altered the mixing ratio. When they perceived the cleaning product was not strong enough, they circumvented the dilution control system and increased the amount of the chemical ("We take a screwdriver off and then put in a whole bottle in the bucket." "You have to make it stronger to work").

New technology commonly mentioned by focus group participants included microfiber mops and cloths, flat mops, auto scrubbers, buffing machines, wet/dry vacuums, and Kaivac machines. Most of the custodians liked the microfiber cloths ("Those work great. Very good, very good. Cause you can go both ways, wet and dry and sweep and mop at the same time. And these don't left the dust in the air. Yeah we love those mops"). However, a few noted that the microfiber mops were not as effective because some were smaller than the cotton mops (e.g., "Those green ones. Oh, man, you call that a mop. I thought they were handkerchiefs"). Our results indicate that custodians did not receive training on the new technology nor were they integrated into the decision-making process for purchasing new equipment and cleaning systems.

Material Safety Data Sheets

All enrolled agencies had initiated some form of EPP program except one (at which a pilot best-practices project was subsequently initiated). A total of 106 material safety data sheets were collected across all sites (one site provided 53 MSDSs, but only the 27 products that were reported as routinely used were included in the analysis).

Table 2 shows that custodians have access to both traditional and EPP cleaners, and only 26 to 44 percent of cleaning products available at the sites were EPP. At four sites, approximately 50 percent of the traditional cleaning products were packaged for the closed dilution control systems, including non-acid bathroom cleaners, heavy-duty cleaners, bathroom and shower cleaners, and floor care products. The use of disinfectants across sites ranged from 9 to 31 percent of all

Table 2. Distribution of Types of Cleaners Used at Sites

	Traditional		EPP		Disinfectant		Concentrates		
Site	Number	Percent of all products	Number	Percent of all products	Number	Percent of all products	Number	Percent of all products	All products
A[a]	17	63	7	26	3[b]	11	14	52	27
B	9	53	6	35	2	12	10	59	17
C	5	38	4	31	4	31	8	62	13
D	5	31	7	44	4	25	4	25	16
E	12	55	8	36	2	9	12	55	22
Total used at site	56	53	33	31	17	16	48	45	106

[a]At Site A, a total of 53 products were available for cleaning tasks; however, only 27 products were identified as commonly used.
[b]At Site A, a new sanitizer product (an ionized water cleaning product) was being piloted to replace chemical disinfectants.

products, and they were also used in the dilution control systems. Only a few institutions reported using aerosols (e.g., gum remover and stainless steel polish), and some institutions used air fresheners in bathrooms as a common practice.

SUMMARY AND DISCUSSION

Connecticut is one of several states implementing green cleaning programs as a result of a state mandate. This is the first study to characterize perceived incentives and barriers to adoption of green cleaning programs. In Connecticut, state agencies initiated the first step of a green cleaning program by changing some of their cleaning products and some equipment. However, our findings indicate the need to broaden the effort to include new technologies, building materials, and work practices and effective communication with all stakeholders. Quan [41] described three main categories of green cleaning practices that institutions tend to focus on: 1) selecting EPP, tools, and equipment; 2) operational changes (e.g., dilution control systems); and 3) building design (e.g., design elements such as flooring or tools that reduce the need for cleaning). The institutions in this study focused primarily on the first two categories with less emphasis on a comprehensive approach to the adoption of a green cleaning program.

Focus group results identified several barriers to the adoption of a green cleaning program. For example, custodians noted the lack of cleaning effectiveness for some EPP and lack of participatory decision-making for cleaner selection. However, there were also comments supporting the health and environmental improvements associated with EPP. Custodians noted the importance of a strong feedback mechanism among end users (custodians), purchasers, and other stakeholders within the institutional community. This was consistent with another green cleaning study reporting worker perceptions of not being part of the selection process and concerns about equipment and training [34]. Quinn (2006) explains that the successful introduction of an alternative involves a social process in addition to a technical one, and that interventions are more successful when all parties impacted feel they were represented in the change.

Muscle strain due to more scrubbing and the need for repeated applications were also reported with EPP use, which is consistent with the literature on posture and force risks in cleaning tasks [42-46]. However, custodians with ESL found that certain tasks, such as the preparation of mixing chemicals, were easier with the green cleaning program because of the installation of the dilution control systems. Management and workers at most sites tended to report verbally that they were using all EPP for their general routine cleaning tasks. However, our study found that less than 50 percent of the cleaning products available for use were EPP.

Solutions to the barriers identified in this study for an effective green cleaning program include the following:

1) Clarify the meaning of "green" and inform custodians about the difference between an EPP and a traditional cleaner. Confusion between EPP and traditional

cleaners was a consistent theme across all institutions, with workers assuming all the cleaners in a product line are EPP, including the disinfectants. More than 50 percent of all products were concentrates used in the dilution control systems, but most were not EPP (including disinfectants, which are not eligible for EPP status). The practice of using both EPP and traditional products in the dilution control systems may have led to confusion and may explain why workers were not able to identify products as EPP. This confusion may increase the use of non-EPP products, including disinfectants (which appeared to be greatly over-used). While custodians reported that the EPP were safer for the environment than the traditional cleaners, there was some skepticism about the possible long-term effects of the products on worker health. Green Seal recently added a screen for known asthma-causing chemicals in cleaning, although there are underlying problems for developing lists, such as generally poor information on the toxicity of chemicals [47] and the actual use patterns of cleaners (such as the need for re-applications).

2) Improve communication and feedback mechanisms. The data indicate that there is a need to transfer best practices and cleaning techniques more systematically to all workers across agencies. It also shows the need to include other stakeholders (e.g., food service) so that a more comprehensive systems approach to implementing a green cleaning program is in place. Foscue [35] describes a successful intervention model for implementing green cleaning in schools that includes all parties affected and promotes a comprehensive program in a step-by-step manner. Quan [41] identifies the need for similar stakeholder involvement in a health care setting: "A successful green cleaning program must (i) be fully supported by the management, and (ii) involve administrators, clinicians, infection preventionists, safety officers, housekeeping/environmental services, and clinical laboratory personnel to evaluate the infection prevention and control, occupational health, and environmental performance of the new cleaning program."

3) Newer technologies can greatly enhance green cleaning programs. Existing programs focused primarily on the use of EPP, and could benefit from the use of newer technologies such as integration of microfiber mops, use of walk-off mats, cleaning devices instead of sanitizers or disinfectants, or no-touch cleaning systems. Since EPP are still in the developmental stage (as contrasted with traditional cleaners, for which special-purpose chemicals and techniques have developed over many decades), it is particularly important to be able to identify the most effective EPP. It is difficult to mix and match the most effective products across different manufacturers since it would require multiple dilution control stations in already crowded custodial closets. A national standard for dilution control system design used across product lines (perhaps defined by Green Seal or EcoLogo) would greatly assist in this process.

4) Continue to explore and address the fragrance and shine factor. Both workers and building occupants have strong opinions about the presence of fragrances in cleaning products. These include positive reactions to traditionally

defined "good" smells such as bleach as well as negative reactions to "strong" smells particularly for vulnerable populations. Trying to find a balance between a "clean" smell, no smell, and a bad smell is not easy. Some institutions responded by placing "odor misters" in the bathrooms to create a "nice fresh" smell even though ironically these result in intentional chemical exposures, including ingredients that can cause respiratory symptoms.

5) Training at all levels is important. Training at many levels within the institution is critical, including training for building occupants. Occupants need to be provided information on the new green cleaning approach (including the intended environmental and health benefits) as a way of changing expectations in relation to issues such as scent and shine. Our findings indicate that training on the proper use of disinfectants (e.g., cleaning before disinfecting, not using disinfectants for general-purpose cleaning, and understanding that disinfectants are not currently covered under green cleaning certifications) is needed for both supervisors and workers.

Custodians expressed an interest in more training, such as regular in-services with time to ask questions, especially after they have begun using new product and dilution control systems. Custodians need more effective hazard communication training. The state of New York has a useful website for training all levels of staff involved with green cleaning programs [48].

6) Provide special training for workers with ESL. Spanish- and Polish-speaking participants reported that it would be beneficial to have training conducted in their primary language. While several ESL participants reported that they did not have any problems doing their job because of a language barrier, it is possible that they are reluctant to point out any inadequacies in their job performance. Educational materials with pictures (e.g., graphical posters) were found valuable in transitioning to a green cleaning program.

Limitations of the Study

The focus group component of this research project was qualitative in nature, with a nonrandom sample of custodians from a relatively small number of agencies within a single unionized state government. The data cannot be considered representative of the general population of workers performing cleaning duties in workplaces.

The focus group script was semi-structured, which may have limited the range of comments and discussion, resulting in a heavier emphasis in the areas with specific questions. The project was introduced at the focus group as having a long-term goal of improving green cleaning programs in state agencies. This may have produced an unintended expectation that the researchers were looking for criticism of current programs, biasing the participants toward negative comments. In general, the focus groups reported more barriers to the adoption of a green cleaning program than positive elements. In fact, a detailed qualitative

assessment of the focus group transcripts revealed that of the comments on EPP, 68 percent were negative, 22 percent were positive and 10 percent were neutral.

Senier found that personal experience mediates acceptance: "if custodians were confused or unclear about the importance of health in making the shift to green, it may have reduced their subjective assessment of the new EPP, as their application often significantly differs from traditional products and requires more physical labor" [34]; this may have been true for our study.

CONCLUSION

While there is considerable support from a Precautionary Principle standpoint for the advantages of a green cleaning approach for both worker health and environmental health, this study of the qualitative aspects of adopting a system identifies a number of potential improvements that could address effectiveness issues. Several of our findings, including the advantages of participatory models, the use of safer alternatives rather than control of toxic chemicals, and the need for continual quality improvement for safer alternative programs are consistent with Quinn [31], Quan [41], and Foscue [35].

Since effectiveness is such a crucial aspect, improvements would be likely to drive faster adoption in workplaces that are not covered by state laws directing the use of EPP in governmental agencies. These improvements include better feedback loops from users to purchasers and suppliers to identify the most effective EPP, an increase in the ability to choose products across manufacturers, better training for using EPP safely and effectively, and the use of new technologies to enhance EPP effectiveness.

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