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THE IMPACT OF INTERIOR DESIGN ON HOSPITAL CLEANING:  
CAN GOOD DESIGN DECISIONS HELP CLEANING STAFF ACHIEVE BETTER  
OUTCOMES?

by

Julia Graves Williams

A THESIS

Presented to the Faculty of  
The Graduate College at the University of Nebraska  
In Partial Fulfillment of Requirements  
For the Degree of Master of Science

Major: Architecture

Under the Supervision of Professor Betsy S. Gabb

Lincoln, Nebraska

May, 2012

THE IMPACT OF INTERIOR DESIGN ON HOSPITAL CLEANING:  
CAN GOOD DESIGN DECISIONS HELP CLEANING STAFF ACHIEVE BETTER  
OUTCOMES?

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University of Nebraska, 2012

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Evidence-based design is commonly recognized as the best practice for the interior design of healthcare facilities. Research indicates that careful planning and design can have a positive effect on hospital staff and patient outcome. However, there is a lack of existing research on how interior design effects the cleaning of healthcare facilities. More research is needed to determine the impact of interior design specifically on the cleaning and maintenance personnel of our hospitals and clinics. If designers can make the important job of cleaning and disinfecting healthcare facilities easier then healthcare acquired infections can be reduced saving lives and billions of dollars per year.

## **Acknowledgements**

I would like to acknowledge those that have helped encourage me to pursue challenges throughout my life. I have had some marvelous, strong and bright teachers, not all of them in school. My parents supported and pushed me to be curious about the world. My father was a career academician and believed the most important thing any of us could learn was an understanding of the world and all of us that inhabit it. My mother was an intelligent and glamorous partner and together they charmed everyone they encountered. They were involved in life to the fullest and set a wonderful example of how important it is to seek understanding. I miss them both terribly, but know they would be proud of my efforts.

My darling daughter has endured my pursuit of a Master's degree and the time I have had to spend working. She has been nothing but patient and encouraging and I could not be prouder of her. I hope my efforts inspire her to continue learning throughout her life as my parents and grandmother inspired me. I so appreciate the support I have had from my family and friends, particularly in the last couple of years during this crazy, hectic endeavor.

I would also like to thank all of the teachers I have been blessed to have that pushed me to do my best and challenged me to grow along the way. I have been so lucky to have had too many to name individually, so I thank them collectively here.

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## **Introduction**

The population of the United States is aging and increasing the need for healthcare. New methodologies and technology, changes in healthcare privacy laws, risk management and infection control, and competition for customers are changing the way we design healthcare facilities. Evidence based design is an increasingly more practiced design strategy in healthcare facilities and has been shown to improve outcome for patients and healthcare staff (McCollough 2007, 2). But careful attention also needs to be paid to facility maintenance. Studies have shown that the spread of infection in our hospitals is a leading cause of death (Klevens et al. 2007, 160-161). Research also indicates that many of these infections can be control through proper hygiene, and facility cleaning and maintenance (Dancer 2008,112).

The increased demand for healthcare has also created an increased need for the retention of a well-trained healthcare team, caregivers in addition to those that maintain the facility. Literature exists to support the link between the designed environment and the role it plays in the way caregivers work and how evidence based design can have a positive impact on workflow, patient safety and staff retention. However, there was little research specifically targeted to how evidence based design effects the cleaning maintenance staff of healthcare facilities. More research is needed to determine if interior design practices can lead to improved outcomes for patients and their families, caregivers and those that work to keep our healthcare facilities cleaner and safer.

**Research Question:**

**Can interior design practices positively impact the housekeeping staff and their ability to clean healthcare facilities?**

**Justification**

Healthcare facilities are unique in that they have to operate on a twenty four hour basis, and they should meet scrupulous standards for cleanliness and safety. The need for healthcare facilities to meet these standards will become increasingly more important as the demand for care increases.

The population of the United States is aging. In 2011, the first of the so-called baby boomer generation, those born between 1946 and 1964, started celebrating their sixty-fifth birthdays. According to United States government projections, the percentage of Americans over the age of sixty five is expected to be 26% by 2030, compared to 17% now.

- Thanks to improving longevity, there will be about six million Americans age 85 or older in 2010—twice as many as in 1990.
- In 2031, when the baby boomers begin reaching 85, the number of the oldest will begin rising rapidly, growing to an estimated 21 million by 2050 (Population Resource Center, 2012).

Demand for interior design services from the healthcare industry is expected to be high because of an anticipated increase in demand for facilities that will accommodate the aging population. Designers will be needed to make these facilities as comfortable and homelike as possible for patients. (U.S. Bureau of Labor Statistics, 2012). Many facilities are aging and becoming out of synch with the methodologies and technology used to treat patients. The benefits and costs of renovating outdated facilities must be weighed against those of new construction and carefully considered. In either case, designers will be in demand to lend their expertise to a complicated project (Young et al. 2008).

These changes are creating more opportunities for interior designers specializing in healthcare facility design. Interior designers working in the healthcare sector have a responsibility to improve patient outcome in any and every way possible. Because of the lack of existing research which specifically targets how interior design can affect how the engineering and maintenance team works, more research on this topic is necessary. If designers can use evidence from previous projects to design facilities that are easier to clean and maintain, then the spread of deadly and costly healthcare acquired infections can be reduced.

## **Review of Literature**

According to the Center for Health Design,

“Evidence-based design is the process of basing decisions about the built environment on credible research to achieve the best possible outcomes.”

(Center for Health Design, 2008)

In her book on the subject, Cynthia McCollough wrote that an evidence-based designer along with an informed client make decisions based on the best information available from research, project evaluations and from evidence from the client’s operation, which should result in improvements in the organization’s utilization of resources (McCollough 2010, 2).

Existing research suggests that careful healthcare design can improve patient outcomes and decrease medical errors and waste, but that it is not an exact science or a guarantee of good outcome (Marberry 2006). In order to develop and test the efficacy of evidence based design, the Center for Healthcare Design created a research project, called the Pebble Project. The Pebble Project is a multi-year field research project. The two main concerns of the project are understanding how organizational behavior changes because of the designing process, and the development of a standardized evaluation methodology, leading to the comparison of outcomes, the identification of best practices, and continuous improvements of healthcare design. The Pebble Project research supports a patient centered approach to the design and methodology of health care (Center for Health Design 2002).

Results of the study also included important observations about how care givers work. Patient centered design leads to fewer transfers which in turn leads to increased efficiency and reduced workload for staff. Fewer transfers also lead to fewer errors with patient information and medication, and lower costs per case (Center for Health Design 2002).

Problems with U.S. healthcare not only influence patients; they impact staff. Registered nurses have a turnover rate averaging 20 percent (Joint Commission on Accreditation of Healthcare Organizations 2002). Beyond the aesthetic and psychological aspects of interior design for healthcare facilities, existing research indicates that evidence-based design has a positive impact on patient outcome and improves how hospital staff functions (McCullough 2009).

Many of these research studies focus on the patient and the healthcare provider, but what about those responsible for cleaning and maintaining the healthcare facility? Research indicates that environmental design may impact cleanliness or the ease of cleaning and disinfecting healthcare facilities.

According to the 2001 edition of *Guidelines for Design and Construction of Hospital and Health Care Facilities* by the American Institute of Architects (2001), medical errors and healthcare acquired infections (HAIs) are among the leading causes of death in the United States, each killing more Americans than AIDS, breast cancer, or automobile accidents (AIA 2001). There is research to indicate that cleaning can help contain some of these hospital acquired infections (Dancer 2008, Ulrich and Zimring 2004). Surprisingly, this connection between cleaning and the spread of infection is

relatively new.

Dr. Joseph Lister was one of the first physicians to understand the importance of cleanliness to the prevention of the spread of disease (Figure 1). A British surgeon and a follower of Louis Pasteur, he was one of the earliest in the medical profession to understand the link between cleanliness and the prevention of spreading infections. He and Pasteur agreed that surgeons should wash their hands and sterilize their instruments before operating on patients. Before Lister first demonstrated this practice in 1865, about half of all surgical patients died from infection. Cleanliness was not even a consideration. Lister used carbolic acid to clean the surgical area and his tools and was able to keep his ward in Glasgow, Scotland free of infection for nine months (Herd 1998).



**Figure 1-Dr. Joseph Lister**

Source: [http://www3.bc.sympatico.ca/st\\_simons/cr9801.htm](http://www3.bc.sympatico.ca/st_simons/cr9801.htm) (accessed February 17, 2012)

In 1876, Lister traveled to the US to present his ideas at the International Medical Congress in Philadelphia. In attendance was William W. Keen of Jefferson Medical College, who had garnered a formidable reputation in cranial surgery (Figure 2). Keen was one of the few surgeons who realized the practical importance of infection control, and he became one of the first American surgeons to implement Lister's system.



**Figure 2-Dr. William Keen**

Source: <http://www.medscape.com/viewarticle/503947.htm> (Accessed February 17, 2012)

The following is a description of Dr. Keen's surgical setup:

All carpets and unnecessary furniture were removed from the patient's room. The walls and ceiling were carefully cleaned the day before operation, and the woodwork, floors, and remaining furniture were scrubbed with carbolic solution. This solution was also sprayed in the room on the morning preceding but not during the operation. On the day before the operation, the patient's head was shaved, scrubbed with soap and water, and ether, and covered with wet corrosive sublimate dressing until operation, then ether and mercuric chloride washings were repeated. The surgical instruments were boiled in water for two hours, and

new deep-sea sponges (elephant ears) were treated with carbolic and sublimate solutions before usage. The surgeon's hands were cleaned and disinfected by soap and water, alcohol, and sublimate solution (Miller et al.2005, 3).

That early description gives us an early picture of how the link between the design of the care environment and cleanliness and its impact on the spread of infection began to form. Today, multiple studies in medical journals confirm the importance of cleaning to the control of specific bacterial infections that are dangerous to human health, such as Methicillin-Resistant Staphylococcus (MRSA) or Clostridium difficile (Dancer 2009).

A review by British microbiologist, Stephanie Dancer found evidence that so-called “super-bugs” such as MRSA and Clostridium difficile are vulnerable to cleaning in hospitals. Cleaning can be effective if careful attention is paid to high-touch sites that are particularly close to infected patients. These sites include over-bed tables, light switches, nurse-call buttons and privacy curtains (Dancer 2009, 379).

Multiple articles in medical journals with support there is strong evidence that cleaning removes MRSA from the ward environment with benefit for patients (Dancer 2008, 2009). An outbreak of MRSA lingered for several months on a urological ward, resisting all the usual infection control interventions such as promotion of hand hygiene and isolation of patients. The investigating team found the outbreak strain of MRSA scattered throughout the ward environment and doubled the number of facility cleaning hours from 60 per week to 120. Following this, there was no further isolation of

the outbreak strain from the environment and the number of patients affected decreased immediately. The cleaning intervention was thought to have played a significant role in the termination of the outbreak (Dancer 2009, 379).

But Dancer also points out that hospital patients can acquire organisms from many sources, including the environment, but the extent to which the latter contributes towards HAIs is largely unknown (Griffin et al. 2000, 19). This is because cleaning has never been regarded, let alone investigated, as an evidence-based science. The difficulties in measuring cleaning efficacy are compounded by the lack of standardized methodologies and are rarely quantitative. She suggests that a more evidence based design approach to cleaning would help develop standards for the evaluation of cleaning and disinfection, but that this can be difficult to measure because most researchers agree that staff must follow guidelines from manufacturers on cleaning and disinfectants (Dancer 2009).

Another study indicates that environmental design factors have had an effect on the spread of infection in healthcare facilities. One such design element is the single patient room which enables a proactive separation of patients upon admission, making it possible to prevent infection from unrecognized carriers of pathogens. Single patient rooms are easier to clean and decontaminate between patients. Private toilets help contain the outbreak of infections such as *Clostridium difficile* and norovirus (Ulrich and Zimring 2004, 2).

The spread of *Clostridium difficile* is a growing concern. According to

the Mayo clinic definition, *Clostridium difficile* is a bacterium that can cause symptoms ranging from diarrhea to life-threatening inflammation of the colon. Illness from *Clostridium difficile* most commonly affects older adults in hospitals or in long term care facilities and typically occurs after use of antibiotic medications. In recent years, *Clostridium difficile* infections have become more frequent, more severe and more difficult to treat.

Recommendations for prevention of the spread of *Clostridium difficile* include the proper washing of hands as well as thorough cleaning of the infected area with bleach. The bacteria causing this disease have been known to survive cleaning with non-bleach Cleaners (Mayo Clinic Staff 2010).

Ulrich and Zimring (2004) found four basic assumptions where there was compelling amount of research to drive design decisions. Reducing staff stress and fatigue increases the effectiveness of delivering care. Design changes can lead to better quality of care and patient safety. Reducing patient stress speeds the healing process for patients and families. Overall improvement of health leads to reduction of costs (Malloch and O'Grady 2006, 344).

Evidence also supports the positive impact of evidence-based design on hospital staff, especially nurses. According to Malloch and O'Grady (2006, 243), "goodness of fit between the built environment and practice is critical to the success of the healthcare system." But there is a need for more research that specifically targets housekeeping staff.

The emergence of sustainable design in recent years is now changing how healthcare facilities are designed. Existing research has shown that sustainable practices in facility design can result in lower cost of ownership as well as improved patient outcome. There is also evidence that green practices can improve the working conditions of the facility staff (Markkanen et al.2011.15). This indicates that designers specifying materials which can be cleaned with cleaners that have less harmful side effects can have a positive effect on the well-being of the healthcare staff, patients and their families.

A study by Bello, Quinn, Perry and Minton found that cleaning products are mixtures of many chemical ingredients of concern that may impact worker health through air and dermal exposures. Because cleaning exposures are a function of both product formulations and product application procedures, a combination of product evaluation and workplace exposure data is necessary to develop strategies for protecting workers from cleaning hazards. The task based assessment conducted here allowed classification of cleaning tasks in different exposure categories, a strategy that can be employed by epidemiological investigations of the impact of cleaning on health (Bello, et al. 2009).

Cleaning products have also been shown to be a primary cause of work-related asthma, particularly in nurses and cleaning staff. In addition, some of these products contain persistent, bio-accumulative and toxic chemicals (PBTs), are classified as hazardous waste, and/or otherwise contribute to environmental pollution during their manufacture, transport, use, and/or disposal. In healthcare settings, continuous 24/7

building occupancy necessitates cleaning while the building is occupied. Nontoxic and least-toxic cleaning products exist for nearly every healthcare facility need. Green cleaning practices can reduce toxicity, reduce waste and improve risk management (Bello 2007).

Conventional cleaning products can contain chemicals associated with respiratory irritation, skin and eye injury, ozone depletion, cancer, and indoor air problems. Based on state occupational injury reporting, janitorial staff has some of the highest on-the-job injury rates. Research identifies nurses as having the highest rates of work-related asthma of any occupation in the study (Arif et al. 2009), and another study pointed to the use of cleaning chemicals as a probable trigger for work-related asthma in facilities where strong disinfectants are used (Vizcaya et al. 2011). Choosing less toxic cleaning products and using them in combination with effective cleaning practices is a key strategy for reducing worker exposures. (Markkanen et al. 2009)

The change to environmentally sensitive cleaners will not be easily implemented. Though there is research showing that hypochlorite (bleach) is an effective disinfectant, it is difficult to say whether the cleaners or the extra effort cleaning regardless of the cleaner are to be credited. There are also concerns about the toxicity of bleach in strong concentrations (Dancer, 2009). Despite these concerns, the Center for Disease control recommends the use of bleach solution for disinfection in healthcare facilities (CDC 2010).

Some literature has conflicting information regarding the use of antimicrobial surfaces and the possible side effects of the manufacturing and disposal process. Antimicrobial products, including building materials and interior furnishings, are being marketed heavily to healthcare facilities and those that design for them. Most products are enhanced for infection control with some type of antimicrobial material. Some are metals, such as copper or silver. They are used in everything one might find in a healthcare setting including: paints, flooring, upholstery, privacy curtains, door handles and wall protection. Research on the subject indicates some degree of efficacy. For example, one clinical trial found a 40% to 70% reduction in *Clostridium difficile* infection in a room with copper antimicrobial interior elements such as nurse call buttons and handrails (Efstathiou, 2011).

However environmental concerns loom large. Metals can leach into our water air and soil during the manufacturing process (Hansen, 2007). Some products use nanotechnology, which researchers have linked with potential environmental and health concerns (Harthorn, 2009; Virginia Tech, 2010). Ironically, antimicrobial products may also contribute to anti-biotic resistance. The efficacy of these products has also been called into question from some researchers. In fact, the Center for Disease Control found no evidence that these products controlled the spread of infection in a 2003 study. Healthcare giant Kaiser Permanente does not use antimicrobial products as part of their effort to prevent hospital acquired infections. They instead have decided to focus on hand hygiene and the cleaning and disinfection of surfaces (Bartley et. al. 2010).

The housekeeping department probably is the most under-rated of all the hospital service departments. A large number of hospitals now realize that in addition to quality of care, other important factors that consumers should consider in choosing a hospital include the quality of its housekeeping services (Gupta 2001)

## **Case Study 1**

### Research Methodology

In order to research the cleaning methodology at some of the healthcare facilities in the southern Indiana region, information from the managers of the housekeeping departments was needed. A questionnaire was written in order to get information from the managers about how their housekeeping staff worked and to determine if links existing between the designed environment and the manner in which the staff operated. Questions were written in order to research how the environment might impede or assist the staff, not to evaluate any particular cleaning method used.

Managers of the Environmental Services departments at five regional hospitals in the state of Indiana, four in the Evansville area, and one in Indianapolis, were sent questionnaires by electronic mail. The survey included questions regarding the facilities current cleaning practices and issues as well as questions concerning the locations of water supplies and cleaning supply storage. In order to determine if the moving of furniture was required to clean the spaces, there were questions asking if this was involved in the cleaning routine. The questions were a combination of multiple choice and yes/no styled answers, delivered through an on-line questionnaire that was sent directly to the managers that had responded to a permission letter also via electronic mail.

**The following is a list of the hospitals that were included in the survey:**

**Deaconess Hospital, Evansville, Indiana**

**Deaconess Gateway Hospital, Newburgh, Indiana**

Deaconess Health Systems serves the Tri-State area around Evansville, Indiana with two large hospitals. The older and largest of the two hospitals is a 365-bed facility in downtown Evansville. Many additions have been made to meet increased demand for services based on the growth of the city and to accommodate the changing technology used to treat patients and keep records (Figure 3). Deaconess is in the midst of renovating the patient units and public lounges as they convert to single patient rooms and electronic medical records. Deaconess Gateway Hospital is a 145 bed facility in the suburbs of Evansville (Figure 4). The first tower was completed in 2006, with another bed tower added in 2009.

**St. Mary's Medical Center, Evansville, Indiana**

St. Mary's is one of the largest faith-based health ministries in the Southern Indiana tri-state area, and has been serving the region for more than 135 years by its mission of serving all persons, with special attention to those who are poor and vulnerable. It is part of Ascension Health, the largest group of Catholic and non-profit healthcare facilities in the United States. Saint Mary's Medical Center has 463 beds and is serviced by 750 physicians (SMMC Website).

**Veteran's Administration Outpatient Clinic, Evansville, Indiana**

The Veteran's Administration Hospital in Marion, Illinois decided to build a new outpatient facility to replace its outdated one in Evansville, Indiana. The new facility opened in 2011 and features 74 exam rooms and 82 clinic spaces and offices for primary and specialty care, mental health, pharmacy and laboratory services. The clinic serves 15,000 veterans in Kentucky, and Indiana (*Evansville Courier and Press* 2010).

**St. Vincent's Hospital, Indianapolis, Indiana**

St. Vincent Hospital and Health Center is a general medical and surgical hospital in Indianapolis, IN. It scored high in patient safety, demonstrating commitment to reducing accidents and medical mistakes. St. Vincent Hospital and Health Center has 815 beds. The hospital had 34,088 admissions in the latest year for which data are available. It performed 10,486 annual inpatient and 13,315 outpatient surgeries. Its emergency room had 62,209 visits. St. Vincent Hospital and Health Center is a teaching hospital. (Best Hospitals, *U.S. News and World Report*, 2012)

## **Survey, Results and Analysis:**

### **Survey Questionnaire**

#### **How does your cleaning staff work?**

Please answer the following questions regarding how your staff cleans. Information will be analyzed to determine how interior designers might be able to simplify the housekeeping process through evidence based design.

#### **1. How does your staff clean around users in a 24 hour use area?**

- A Clean unused furniture only while guests are in the area?
- B Ask guests to relocate as they are cleaning?
- C Shut down area to clean?
- D Other

Seventy-five percent of the managers answered “B”, they ask guests to relocate as they are cleaning. Twenty-five percent of the managers answered “D” or “other”. Responses indicate that designers should consider this when planning seating in lounges and perhaps try to provide alternative seating for guests to use while the area is being cleaned.

**2. What is your method for cleaning upholstery?**

- A Hot Water Extraction
- B Steam
- C Cleaning Chemical (on wipe or in foam)
- D Bleach solution
- E Vacuum only
- F Other

Fifty percent of the managers answered “A”, that they use a hot water extraction method to clean upholstery. Twenty-five percent answered “C”, they used a chemical cleaner in wipe or foam formulation and twenty-five percent answered “F”, “other”.

These responses indicate that cleaning methods vary from facility to facility and from one kind of surface to another within the same facility. Designers need to gather information about the products and methods used to clean when specifying interior materials to ensure the end user understands how the surfaces need to be maintained for maximum performance. When surfaces can be planned in such a way that simplifies the number of methods/cleaners used, this would make the job of cleaning easier on the housekeeping staff. Designers can also educate the end-user about products requiring simpler maintenance routines.

**3. Do you use a contractor for cleaning upholstery or carpeting?**

A Yes

B No

Twenty-five percent of the managers answered “A”, yes they do use a contractor.

Seventy-five percent of the managers answered “B”, no, they do not use a contractor.

The research indicates that information should be available regarding the cleaning methodology recommended for surfaces either in-house or in a format that could be shared with contractors.

**4. What is the method for cleaning patient rooms between patients?**

A Cleaners with water

B Bleach Solution

C Chemical wipes

D Mechanism to heat the entire room

E Other

Seventy-five percent of the managers answered “B”, they use a bleach solution to clean between patients and twenty-five percent of them answered “E” or other.

Research indicates that designers should specify surfaces that will perform when cleaned with the cleaner that is used by the facility in patient rooms, including bleach solution when applicable.

**5. How often would a typical staff member need to access a water source during a shift? (for changing mop buckets, rinsing rags, hand washing, etc.)**

- A 1-3 times
- B 3-5 times
- C 6-8 times
- D 9-11 times
- E 12 or more times

Fifty percent of the managers answered “A” that cleaning staff needs to access a water source one to three times per shift. The other fifty percent of the managers answered “B”, that the staff needs to access a water source three to five times per shift. Facility space should be planned such that water sources are convenient for staff access.

**6. Are water sources for cleaning easily accessible?**

- A Yes
- B No

Every manager, one-hundred percent, answered “A”, they thought that the current set-up for water access for cleaning is easily accessible for the staff. Research indicates that the current locations in the respondents’ facilities are adequate.

Because of the importance of water access to the task of cleaning, designers should ensure that access is provided near each grouping of patient rooms. Perhaps other methods of cleaning requiring less water could be considered, such as using different micro-fiber pads for each room cleaned.

**7. How important is furniture placement to the ease of cleaning a space?**

- A Very Important
- B Important
- C Neutral
- D Unimportant
- E Very Unimportant

All of the managers answered “A”, they feel that the placement of the furniture is very important to the ease of cleaning the space.

Research indicates designers can impact the ease of cleaning an area with furniture placement. Furniture should be placed such that adequate circulation for cleaning staff is provided for them to do their jobs. Furniture which is open underneath is easier to clean underneath, eliminating the need to move it to clean the floor. Pieces that are heavier or ganged together may be desired in areas where moving should be discouraged.

**8. Does your staff have to move furniture in order to clean the space?**

A Yes

B No

One hundred percent of the managers answered “A” that their staff has to move furniture in order to clean the space.

**9. Does moving furniture create a problem for smaller members of your housekeeping team?**

A Yes

B No

Fifty percent of the managers answered “A”, yes; moving furniture does cause problems for smaller members of the staff. Fifty percent of the managers answered “B”, no, moving furniture is not a problem for smaller staff members.

Research from questions 8 and 9 indicates that furniture that is lightweight and easily moved, or furniture that is open underneath for cleaning may be helpful to the cleaning staff. Ganged or continuous seating such as benches may be indicated where different groups and sizes of users need to be accommodated and the movement of furniture is discouraged. One example of this type of area is the Emergency Department waiting area.

**10. Do you have a floor plan to use to put furniture back in place at the end of your shift?**

- A Yes
- B No

Fifty percent of the managers answered “A”, yes they do use a floor plan to put the furniture back in place after cleaning. Fifty percent of the manager answered “B”, no they do not use them.

**11. If yes, does your staff use them and find them helpful? Or, if not, do you think your staff would find a floor plan to be useful for replacing furniture after cleaning?**

- A Yes
- B No

Seventy-five percent of the managers answered “A”, the staff does find the floor plans helpful to use to replace the furniture after cleaning, and twenty-five percent of them answered “B”, co the staff does not think they are helpful.

Research in questions 10 and 11 indicate that it may be helpful to provide a floor plan for rooms requiring furniture to be moved to clean them.

**12. How are your cleaning supplies stored?**

- A In a locked, centrally located closet on the same floor
- B Locked closet in the unit itself
- C Supply area on another floor of the facility

One hundred percent of the managers answered “A”, that they keep the cleaning supplies in a centrally located closet located on the same floor that is being cleaned.

**13. Would decentralized storage make supplies easier to access?**

- A Yes
- B No

Seventy-five percent of the managers answered “A”, yes decentralized storage for supplies would make supplies easier to access and twenty-five percent of them answered “no” it would not.

Research indicates that lockable storage cleaning supplies should be located in decentralized locations, easily accessed by staff when cleaning. More quantitative research would help to determine the best ratio of supply closet and water access to patient rooms based on the cleaning methods used in a given facility.

**14. On average, how many different cleaners are used to clean a patient unit (Including bed tower and lounges)?**

- A 1-3
- B 3-5
- C 6 or more

Seventy-five percent of the managers answered "A", their staff uses one to three different cleaners to clean a patient unit and twenty-five percent answered "B", their staff uses three to five cleaners to clean a patient unit. None of the managers answered "C" that the staff used 6 or more cleaners.

**15. Are you concerned about any physical illness or symptoms as a result of the cleaners used in your facility?**

- A Yes
- B No

None of the managers answered "A", yes they are concerned about physical side effects. One hundred percent of the managers answered "B", no they are not concerned about any physical illness or symptom that might result from the use of any cleaners used in their facilities.

**16. Would you prefer to use fewer different cleaners if possible to still clean effectively?**

A Yes

B No

Seventy-five percent of the managers answered “A”, yes they would prefer to use fewer cleaners if it did not compromise cleaning and twenty-five percent answered “B” no, they did not prefer to use fewer different cleaners. Designers can ease the burden of using multiple cleaners by selecting materials that can be cleaned with the same method/cleaners and grouping them together in close proximity. Some manufacturers recommend special cleaning methods specific to a particular surface. This complicates the task of cleaning the space.

**17. Do you train staff to know what cleaner to use for what surface?**

A Yes

B No

All of the managers, answered “A” they do train the staff to know what cleaners are used on each surface in the facility. The designer can simplify the training and cleaning process by grouping surfaces together that are cleaned with the same cleaners.

**18. Are the different cleaners labeled or coded in any way for easy recognition?**

- A Yes
- B No

All of the managers answered “A”, they use labels or a coding system to help staff identify different cleaners.

Research from responses to questions 14-18 indicate that using multiple cleaners can be confusing and creates the need for additional training. Designers could simplify the cleaning process by grouping surfaces that can be cleaned with one cleaner together. For example, the designer may specify upholstery, flooring, window treatments and hard surfaces for tables, etc. that are all able to be cleaned with bleach solution.

**19. Do any of the cleaners used require special safety precautions?**

- A Yes
- B No

Seventy-five percent of the managers answered “A” that the cleaners the staff uses does require special safety precautions. Twenty-five percent of the managers responded “B” no, the cleaners they use did not require precautions.

**20. Is your facility concerned with the environmental impact of the chemicals used to clean the space?**

- A Yes
- B No

Seventy-five percent of the managers answered “A”, yes they were concerned with the environmental impact of the cleaners they used while twenty-five percent of the managers answered “B” no they were not concerned. However, one of the twenty-five percent added a note that the cleaners used at that facility were “very green” which might mean he feels the concern has been addressed by the cleaners they use.

Research from the responses to questions 19 and 20 indicates an interest in the use of cleaners that are less harmful to the environment. Designers should provide appropriate surface specifications that do not compromise air quality and that can be cleaned with environmentally safe cleaners.

Below is a list of comments and suggestions that were left at the end of the questionnaire regarding the design of the space and how it may impact the cleaning staff:

Only one of the managers answered by leaving the comments listed below.

Minimal use of carpet in patient care areas

(Specification of) “no-wax” floor in patient areas

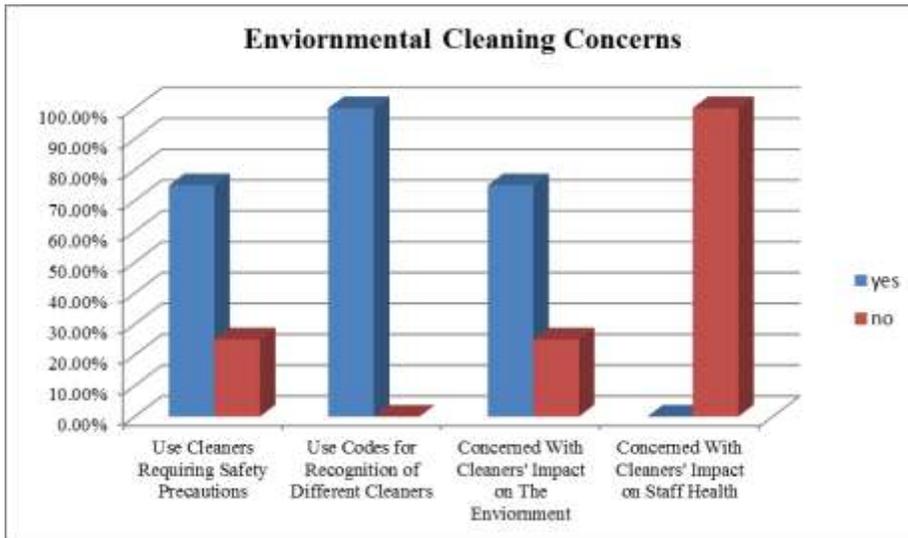
No use of cloth fabric in patient room furnishings, (wipe-off fabrics only)

(Specification of) window treatments that can be wiped clean easily

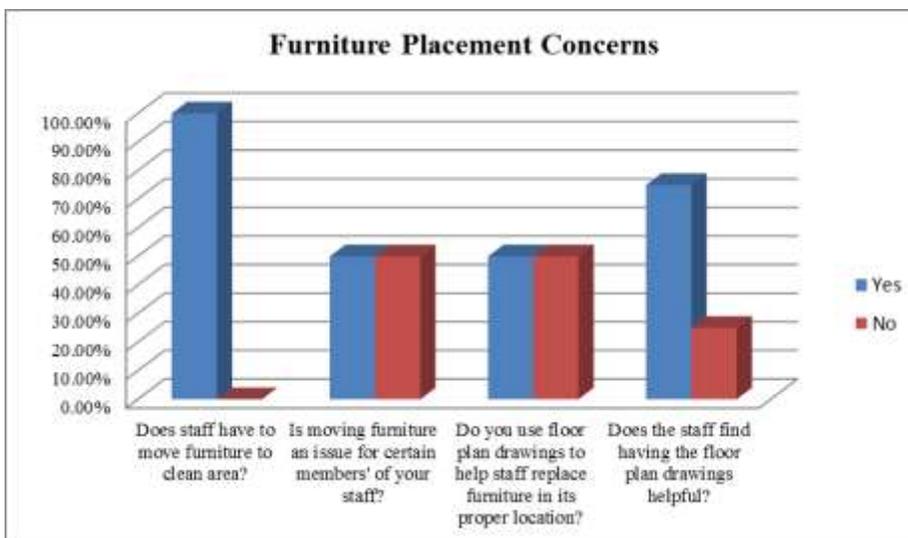
The manager from this facility indicated that these practices are already in place as they renovate or build new care units.

A summary of results from the questionnaire can be seen in the graphs below. (See Tables 1 and 2)

**Table 1**



**Table 2**



## Case Study 2: Comparison of older and newer facilities

The case of the Deaconess Hospital facilities presented an opportunity to compare an older facility, the larger downtown campus (Figure 3) which has been in operation since 1892 and has been changed over the decades, with a newer one, Deaconess Gateway Hospital which has opened in 2006 with an additional bed tower added in 2010 (Figure 4). Both of these facilities are part of a larger regional health system in Evansville, Indiana. These two facilities are both not-for-profit, multi-purpose in-patient facilities. The downtown hospital has 323 beds, the newer suburban hospital has 145 beds (Deaconess website 2012).



**Figure 3-Deaconess Hospital, Main Campus, Evansville, IN**

Source: <http://www.deaconess.com> (accessed November 10, 2011)



**Figure 4-Deaconess Gateway Hospital, Newburgh, IN**

Source: <http://www.deaconess.com> (accessed November 10, 2011)

The following research is based on personal observation conducted in both facilities. The older hospital is in an ongoing remodeling process. One of the more important aspects of the process is the conversion of the semi-private patient rooms to single patient rooms. When the shared rooms were occupied by two patients the beds were in close proximity to one another. The research in the literature review indicated that this was an opportunity for infection to spread from one patient to the other through direct contact. The only place for hand washing is the shared toilet room. Research indicated that hand hygiene was one of the most important factors in the spread of infection, and that the location of the sink should be away from the patient and easily accessed from the entrance/exit to the patient room.

In addition to the risk of improper hand hygiene, the shared toilet room may contribute to the spread of infections such as *Clostridium difficile*. Another consideration is the increase of opportunity to spread illness because of the increase of population in the room when both patients have visitors. These rooms are being converted to single patient rooms and none of these rooms are currently being used by more than one patient at a time.

Patient rooms from the newest tower at the suburban campus of Deaconess Gateway Hospital. Several design modifications have been made to help reduce the risk of the spread of infection. There is now a sink located near the door and away from the patient. This sink also provides access for hand hygiene for the cleaning staff as well as the care team. As stated before, the mere fact that this is a single patient room reduces the risk of the spread of infection. The newer room includes a storage space for supplies

needed within the patient room, such as linens and supplies used to treat the patient.

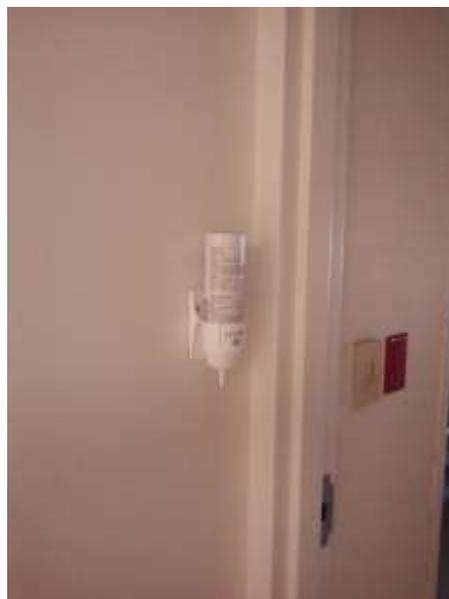
Decentralized storage also helps the cleaning staff by keeping supplies close and easing the burden of changing linens and cleaning the individual rooms.

Figures 5-8 are photographs of the old patient room prior to remodeling and one room that has been remodeled in the older hospital. Figures 9 and 10 are of patient rooms in the new hospital. In addition to the changes in the arrangement of the room as discussed above, there are interior finish differences which affect the cleaning of the rooms. The flooring is a heat welded sheet vinyl which does not require waxing or buffing. The older room had a vinyl composition tile which requires waxing and buffing for proper maintenance. The new floor is less likely to allow for the growth and spread of bacteria. The patient rooms in the newer design standards that can be exercised by interior designers in healthcare facilities that would prevent the collection of contaminated dust, would be built in cabinets which are built up to the soffit without an open space and roller shades of a woven material instead of slats. Roller shades are also more easily cleaned by vacuuming and/or wiping with a cloth or wipe. The mesh fabric in this application is cleanable with a bleach solution.

### Comparison of Patient Rooms



**Figure 5-Shared toilet in older room provides the only place for staff and patient(s) to wash hands.**



**Figure 6-Antibacterial foam hand hygiene stations are added to the wall outside of the room.**



**Figure 7-Shared patient room prior to remodeling.**



**Figure 8-Private room at Deaconess Main Campus after remodel.**

Source: Author's own photographs



**Figure 9-Patient room at newest tower of Deaconess Gateway Hospital showing hand washing station near the door and away from the patient's bed.**

Source: Author's own photograph



**Figure 10-Patient room in new tower at Deaconess Gateway Hospital. Shade cloth window treatment is easier to keep clean. Family area allows proximity to patient.**

Source: Author's own photograph

### **Case Study 3-Research of Market -Questionnaire 2**

It is important to understand the development of interior products for the healthcare market and how the cleaning and maintenance factored into the process, a questionnaire was developed and sent via electronic mail to the sales representatives from two major textile distributors. The sales representatives then forwarded the questionnaires to in-house experts who answered the questions.

Respondent A is the representative from a large textile distributor which develops textile products for several global market sectors, including but not limited to textiles used in healthcare facilities. Respondent A has an academic and professional background in Chemistry and Engineering and is involved in the development of textile products, performance coatings and research. Respondent B is also a representative of a large global distributor of textiles whose customers include healthcare facilities. Respondent B has a sales and marketing background.

**Questions included the following:**

1. What are the considerations for the healthcare market that differ from other sectors?
2. How important is it to consider how the products are cleaned once in the facility?
3. Do you feel that textile specifications can have an effect on infection control?
4. Do you work directly with housekeeping staff or management when considering how products are maintained?
5. Do you “retro-fit” products to how housekeepers are already cleaning or do you train them how to clean your products?
6. Is there an effort to produce textiles that are cleanable by using “green” cleaners?
7. What is the significance of the chemicals used to clean? How do they affect your products? How do they affect the health of the staff or patients and family?
8. Who do you think should train the staff how to maintain and clean your products?
9. What can you share about the direction of products in the future for the healthcare sector?

## Results and Analysis of questionnaire

1. What are the considerations for the healthcare market that differ from other sectors?

Respondents A and B both answered that the demands of the healthcare sector were unique because of the combination of the need for infection control and the high traffic, twenty-four hour use of the facilities. Environmental considerations were also mentioned not only for the concerns of the industrial manufacturing and recycling aspect, but also for the air quality and health concerns within the facility. Aesthetics were also considered important by both distributors in the marketing of products to a healthcare customer that is trending toward a more hospitable and less institutional environment.

2. How important is it to consider how the products are cleaned once in the facility?

Respondent A stressed the importance of working directly with environmental services at the end-user's facilities and becoming part of the cleaning community in order to better understand the needs of the cleaning staff.

Respondent B responded that the process of developing products started with listening to the requests of end-users and specifiers.

3. Do you feel that textile specifications can have an effect on infection control?

Both respondents A and B stressed that textiles and their properties could help prevent the spread of infection, but only if the products were properly specified and maintained according to manufacturer's recommendations.

4. Do you work directly with housekeeping staff or management when considering how products are maintained?

Respondent A responded that the cleaning staff was involved and considered throughout the textile development process. Respondent B answered that their approach was more demand driven and that they would consult directly with housekeeping on occasion as part of their quality control function after the sale of their product to an end user.

5. Do you "retro-fit" products to how housekeepers are already cleaning or do you train them how to clean your products?

Respondent A answered that they share information through an extensive cleaning manual aimed at educating designers, end users, and more specifically the housekeeping staff about the specifications of the product as well as how to best maintain it. They also develop training videos and materials aimed at sharing information with the sales team, designers and end users. Respondent B answered that testing is done at the mill level with that data then written into the textile specification. Both respondents stressed the importance of the use of an educated sales force to share information with the specifiers.

6. Is there an effort to produce textiles that are cleanable by using “green” cleaners?

Respondent A answered that they offer cleaning kits for their products that feature green cleaners. Respondent A evaluated all new high performance upholsteries with a range of green cleaners in addition to the standard cleaning agents. Respondent B said that many of their cleaning instructions recommend warm soap and water. Actual cleaners/brands are not suggested.

7. What is the significance of the chemicals used to clean? How do they affect your products? How do they affect the health of the staff or patients and family?

Respondent A answered that they read Material Safety Data sheets on cleaning agents and disinfectants so they can be knowledgeable about the good and bad properties of cleaning chemicals. They also consult with chemical companies on specific projects. That distributor has an Environmental Strategy Department that works closely with the technical areas of the distributor so that knowledge about the health and safety of the chemicals and products is maximized. The respondent keeps a library of cleaning products in house for testing. Respondent B responded that usually a specific chemical recommendation comes from the success of removing a stain.

8. Who do you think should train the staff how to maintain and clean your products?

Respondent A responded that it was important to train not only the housekeeping staff but the end user and designers through the sales force.

Respondent B answered that it is important for the facility to understand what they are purchasing. They often provide the seller with a cleaning care kit, but that they are not directly involved in training on most jobs.

9. What can you share about the direction of products in the future for the healthcare sector?

Respondent A answered that the future in healthcare textiles will see the continued expansion of higher performing products offerings with increased and more durable stain resistance and easy cleaning properties. This respondent also felt that the industry would try to develop more sustainable solutions and textiles with more inherent properties such as anti-microbial, flame-retardancy, self-cleaning. The respondent also predicts increased use of nanotechnology to deliver desired properties to the product without the use of chemical coatings, which can have negative environmental consequences including the release of Volatile organic compounds (VOCs). But the respondent also stated that industry trade associations will need to be stronger about enforcing the standards regarding false claims made by companies about the properties of the products. Designers need to carefully research products to separate fact from a sales pitch. Case studies on

how these products perform over time would be useful to designers when they are researching for their healthcare projects.

Respondent B emphasized the significance of solution dyed nylon products because of their ability to be cleaned with bleach solution as well as its durability. It provides high durability as well. Respondent B stressed the importance of developing products focusing on the properties of fiber and construction. Respondent B indicated that the company would continue to add chemical coatings to the products to enhance performance. The only concern mentioned about added finishes was the limitation of color offerings, which Respondent B felt were improving.

**Additional commentary and field observations of textiles in the field:**

In addition to the questionnaire, both respondents elaborated on the process for the development of product and some of the issues facing the textile industry with regard to claims made when marketing product to the healthcare sector.

The following is an example of failure of textile performance which occurred at Deaconess Hospital (Figures 11 and 12). A textile from a different distributor with an abrasion rating of over 1,000,000 double rubs was specified for several lounge areas in a high use area of the hospital. Although the distributor's sales representative was surprised by the failure of this fabric, relating stories of women in high heels dancing on the same fabric in a hotel club, it clearly was not performing well in the hospital. The fabric was peeling away from its backing and splitting at the seams in less than one year's time. The textile mill tried to include the furniture manufacturer in the blame, yet the same furniture with different upholstery was not showing the same signs of deterioration.

It was concluded that either the textile was an inferior lot from the mill, or more likely, was breaking down from the cleaning wipes (containing bleach) used by the staff. Even though the fabric was considered very high performance from the abrasion rating, the chemicals in the cleaner used by the staff were likely causing some chemical breakdown of the textile. The damaged fabric not only looks bad, but is of concern to the infection control team. The roughed up fabric surface can harbor bacteria that can cause the spread of infection from one user to the next. The infection control team at Deaconess was very concerned about this issue and demanded that the furniture be removed from the lounge immediately and reupholstered.



**Figure 11-Chair with fabric finish deterioration from exposure to bleach wipes.**

Source: Author's own photograph



**Figure 12-Fabric finish wearing off at seam.**

Source: Author's own photograph

Respondent A commented that most fabric suppliers in the contract fabric industry are surprisingly poorly trained for asking the proper questions. Respondent A felt it was important for sales representatives and assistants to be properly trained to ask the critical questions before a specification is made especially for a large project in critical spaces.

Many textile mills that supply distributors are even less educated about healthcare than the distributors are and most cannot be relied on for useful guidance and research. Reading the cleaning manual written by this distributor can give some idea on the different recommendations and warnings associated with the main textile types and finishes that are sold the healthcare market.

Respondent A expects that the housekeeping departments have to make decisions on the most common methods of cleaning because they have so many different upholsteries in any given space within the facility and that there are typically no care labels on furniture. Respondent A also assumes that furniture may not be intentionally arranged by which types can be cleaned by the same agents and methods, so the risk of harming upholstery alone is high. The respondent believes that cleaning and disinfection protocol is best discussed early in the specifying process so that specifiers do not pursue the wrong product applications. One example given was the specification of textiles that should not be cleaned with a solution of bleach in an area where cleaning with bleach is standard protocol because of a concern about the spread of specific illnesses such as *Clostridium difficile* and MRSA.

It is the opinion of Respondent A that it is critical for manufacturers and distributors to work closely with the end user, including the housekeeping staff. It is key that the designers and sales force be educated properly on product and of the practices of the end user so that the best specification can be made. Education of the end user on how to maintain the product is critical to the success of its performance over time. The need for the best specification is compounded by healthcare facilities with less than ideal housekeeping strategies due to lack of training, budget constraints and turnover.

Respondent B commented on how products are developed for the healthcare customer. They have a team of healthcare interior designers specializing in healthcare facilities that evaluate textile collections for them. Distributor B also uses field testing to study the performance of specific fabrics in the healthcare environment. Distributor B

pays close attention to what characteristics are requested in their customs department and tries to determine possible trends not currently being met by existing products in the market.

Respondent B also indicated that cleaning of the fabrics is always a concern because of the stronger chemicals which are used in the healthcare market. They are definitely noticing increased demand for fabrics that can be cleaned with a bleach solution. When asked about the performance of their products in the facility, they emphasized the importance of proper maintenance. The lack of proper maintenance can result in the customer's dissatisfaction with the product. Some fibers and topically applied treatments for fabrics can provide additional stain resistance and provide a moisture barrier.

But in some cases the product was over sold to the consumer, leading them to believe they could be more easily maintained than was actually the case. Some customers were also disappointed to discover that the product also required a special cleaning agent, which was not one commonly used by healthcare facilities. Lack of proper maintenance often leads to the ultimate failure of the product. This distributor stated that better trained representatives can help educate both specifiers and end-users would help avoid disappointment with the product both by giving the consumer realistic performance expectations and the tools they need to properly maintain the product so that it performs to its potential (Figure 13).



**Figure 13-Chair with Crypton fabric was not properly cleaned and maintained. The end-user was disappointed that the fabric did not resist staining as expected, but also failed to clean according to manufacturer's recommendation.**

Source: Author's own photograph

Distributor B believes that when their textile products are properly specified, they can help the housekeeping staff control infection, but that an important part of the specification is proper maintenance. Some facilities fail to realize that the products are not self-cleaning. It is important for the facility to understand what they are buying. Another way their fabrics can help prevent the spread of infections with the application of specific finishes. One example is Bio-Am which can be applied to a fabric to increase its antimicrobial capabilities.

Distributor B stated that the development of any new collection of textiles begins with aesthetics. There is a trend for healthcare collection designs to relate to the "natural" environment. After a collection or patterns are selected, it then has to be determined what mill can weave the collection. This is a difficult selection. Many times several mills are asked to develop a blanket of the patterns. The product team then determines which mill achieved the best results. Once the mill is selected it is then decided how to treat the

textiles. Very few mills work with solution dyed nylons and not all fabrics pass with added coatings (such as crypton, etc).

### Recommendations: Design for better cleaning



**Figure 14-Corridor with cleaning cart at Deaconess Gateway Hospital.**

Source: Author's own photograph

Let us consider an evidence based approach to design that includes hygiene and the cleanliness of the healthcare facility. There are new and very specific guidelines from the Guidelines for Design and Construction of Hospital and Healthcare Facilities, 2010, formerly known as “AIA Guidelines” within treatment areas of healthcare facilities (Bartley et al. 2010, 2).

Because of the importance of hand-washing to the prevention of the spread of healthcare acquired infections, the first design standard to be considered is the location of sinks for hand hygiene. Sinks in older facilities can be hard to locate, or in a location that does not comply with new regulations (Figures 15 and 16). When sinks cannot be relocated or sinks cannot be added a wall mounted anti-bacterial foam can provide a way to clean hands in the proper location. New guidelines indicate that the sink should be at least 36” from the patient and near the door, with a splashguard.(Stroupe, 2010)



**Figure 15-Can you find the sink in this patient room?**

Source: <http://www.handhygiene.org/downloads/HHRCclinicalmodule123002.ppt>  
(Accessed October 9, 2011)



**Figure 16-The arrow indicates the location of the sink behind the medical equipment. It is also too close to the patient.**

Source: <http://www.handhygiene.org/downloads/HHRCclinicalmodule123002.ppt>  
(Accessed October 9, 2011)

Specifying products that can reduce the collection of dust may prevent the spread of infection through inhalation. Consideration should be given to the use of vertical or horizontal blinds in patient and treatment rooms to control light and maintain privacy (Figure 17). A woven shade-cloth would be more easily wiped clean or vacuumed and does not collect as much dust and is also easier to clean (Figure 18).



**Figure 17-Vertical and horizontal blinds in close proximity to patients can collect infected dust.**

Source: <http://www.kuhnsandheller.com/commercial/> (Accessed October 9, 2011)



**Figure 18-Woven shade cloth is more easily wiped clean or vacuumed and does not allow for the accumulation of as much contaminated dust.**

Source: [www.mechoshade.com](http://www.mechoshade.com) (Accessed October 9, 2011)

Research indicates that design can benefit the cleaning staff's efforts to clean and disinfect healthcare facilities. In the illustration of an exam room below the hand washing station is located away from the patient and is easily accessible for caregivers (Figure 19). The casework is open underneath to allow for more thorough cleaning of the floor. The furniture is light weight or on casters so that cleaning staff can easily move it to clean underneath.



**Figure 19- Exam Room by Nurture by Steelcase**

© 2011 Steelcase Inc. All rights reserved. Design by Nurture.

nurture

Source: [www.nurture.com](http://www.nurture.com) (Accessed March 14, 2012)

### **Recommendations: Furniture**

In addition to the placement of furniture with regard to space planning, designers could make cleaning easier by planning the cleaners needed to clean a particular area and group together surfaces that can be cleaned and disinfected with the same cleaners. This would allow the cleaning staff to simplify their process.



**Figure 20** These gliders are easily damaged on the front from cleaning equipment. They are heavy and awkward to move for cleaning.

Source: Author's own photograph



**Figure 21-** These gliders are open underneath so the floor can be cleaned without moving them. The metal legs are not as easily damaged by vacuums or buffers.

Source: Author's own photograph

Gliders are popular seating in lounges because they allow the user to glide back and forth. The motion is very soothing and can help alleviate stress. The gliders below have been in place for three years (Figure 22). Even though a durable fabric designed for use in a healthcare setting was specified, damage from contact with vacuums and floor buffers, as well as the backs of users shoes can be seen on the lower portion of the front apron. The research indicated that there are several problems to consider when specifying furniture that needs to be moved to be cleaned around. Smaller members of the cleaning staff have difficulty moving larger or heavy pieces of furniture. This would indicate that furniture which is open underneath might be a good solution.

The lounge furniture pictured in (Figure 23) was specified for a small waiting area on a patient bed unit. The seating combines stationary and motion seating, providing some variety for the users in a small space. Because the back and seat are not connected, dirt and crumbs will not collect in the cushions of the chair. They will fall through to the floor where they are more easily seen and cleaned when the staff cleans the floor. The seating is open underneath so that the floor underneath may be cleaned without the staff needing to move the furniture. The metal legs are less likely to be damaged by cleaning equipment than wooden legs or fabric aprons.

#### Recommendations: Collaboration

Designers need to work with the facility team, including environmental services, in a collaborative way to ensure the specification of products that are appropriate for the application and that can hold up to whatever cleaning program the facility decides to pursue. The trend towards more environmentally sensitive practices in design and

facility management can enhance each other provided that the specifications are appropriate to the application and that the staff is completely trained and monitored to ensure the furnishings are properly maintained.

## **Conclusion**

Developing comprehensive protocols may necessitate creating a multidisciplinary team to examine the issue of environmental cleaning; all those involved need to assess risks for particular areas, patients, and circumstances; and identify interventions that respond to those risks. Members of such a team may include infection preventionists, environmental services staff, environment of care personnel, and clinicians (JHACO 2010).

There is compelling research suggesting an improvement of patient outcome by following evidence based design practices. There is also research indicating that the cleaning and disinfection of hospitals can prevent hospital acquired infections (HAIs). Perhaps the best practice for designers should be to research existing data pertaining to the specific type of environment they are designing and specify the smartest choices possible. There is much conflicting information with regard to the effectiveness of different materials with regard to anti-microbial properties. There is a lot of misleading marketing for products used in healthcare environments. For example, testing of textiles may indicate acceptable performance using specific cleaners in a controlled test, but this does not mean that every member of the housekeeping staff in a specific facility is following the manufacturer's suggested practices to the letter.

More research is needed that provides more quantitative data with regard to precise numbers and locations of design elements effecting the way housekeeping staff works. The environmental services staff should be an important consideration when

designing healthcare facilities and they are too often overlooked. Better research would lead to the development of more precise standards and regulations to support their efforts. Similar to the way there are now quantitative standards designers must meet when designing spaces that comply to the Americans with Disabilities Act (ADA) , there should be a similar set of guidelines that result in the design of healthcare facilities that are inclusive of the needs of the cleaning staff and their ability to clean and disinfect. This would be an important step in the prevention of the spread of healthcare acquired infections, thus reducing the danger and cost of these preventable illnesses.

Additional research is needed to determine if less toxic cleaners can be as effective for disinfecting healthcare facilities. Research indicates that the cleaning method may be as effective as the cleaning agent. More study of this process could lead to green cleaning practices that allow for effective disinfection of the facility without compromising the health of staff of the environment. Designers should research cleaning methods and agents carefully when specifying surfaces for healthcare facilities to ensure top performance.

The research supports that interior designers can positively affect the cleaning process in healthcare facilities and how cleaning staff works. Planning the space thoughtfully, designers can eliminate the need to move furniture and can allow for the simplification of the cleaning process. Specification of products that do not allow dust to accumulate as easily and are more easily cleaned can also make the job of maintenance easier for the staff. Less dust can make it less likely for cleaning personnel to become infected by inhaling contaminated dust from infected patients.

Although there are new antimicrobial products marketed to the healthcare sector, designers must pay careful attention to the possible side effects for the health of users and those that maintain the facility as well as the environmental concerns. Specifiers and purchasers must educate themselves on the long term efficacy of these products and weigh that against the cost and possible problems associated with these new technologies.

The collaboration of designer, manufacturer, facility and environmental services personnel is critical. Better outcome and performance of interior surfaces and furnishings can only occur when all involved have a more complete understanding of the products they are purchasing and how to properly maintain them. Healthcare facilities should invest in better training, perhaps in multiple languages when necessary, for the environmental services staff. The more educated the designer, the end user and those hired to maintain the facility, the better chance for the desired outcome. The outcome in this case is improved health, human lives saved and a reduction of huge healthcare costs.

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